A MANAGEMENT SURVEY OF THE SANDY HILL IRON AND BRASS WORKS

VOLUME TWO

Letter on cover:

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SANDY HILL IRON AND BRASS WORKS

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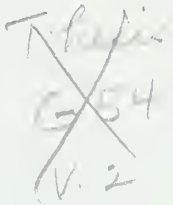


Chapter VI--Marketing and Sales

CHAPTER IV - ENGINEERING

4.1 General. Interviews with various people in the Engineering Department produced a picture of the overall operations of the department. We focused our attention on the areas where we thought we could make the most significant contributions to Sandy Hill in the time available. These areas were:

a. Flow of information
b. Standardization
c. Simplification
d. Classification
e. Engineering drawing errors
f. Product development

Since product engineering is the first major step in planning and producing a product, particular attention was given to the flow of information into the engineering department and the resultant output. At the present time, almost every job must be engineered, and time and cost estimates must be calculated. The flow of information about inquiries, propositions and orders was investigated.

Standardization and simplification in job shops have been considered inapplicable in the past, but today progressive managements are reconsidering this concept. New ideas for classification systems and information retrieval greatly enhance the practicability of a program for increasing standardization and simplification.

One of the tenets of simplification is to eliminate as many operations as possible. If an operation cannot be eliminated, the effectiveness of alternative courses of action relative to the company's objectives must be measured. One measure of effectiveness is cost. The findings of this study indicate that Sandy Hill management, by following a procedure of checking all drawings, may be placing a high value on the avoidance of any engineering errors. We do not think it is necessarily true that it is cheaper to find an error in the drafting room than to find it on the shop floor; the actual costs of both could be established by additional study.

To remain competitive in today's economy, a planned research and development program is a prime requirement. The size of the company and the capital available naturally determine the size and emphasis of the program.

The following sections examine in greater detail the areas cited and in summary set forth the recommendations.

4.2 Inquiries and Propositions. The area of inquiries and propositions is an important one for the company. It is in this area that the potential profit or loss of a job is determined. In a competitive market, the allowance for contingencies must be reduced to a minimum. The Engineering Department, in determining the design for a particular job, creates the framework upon which the costs, such as labor and material, must be applied. Therefore, in submitting preliminary specifications for quotation, the Engineering Department influences to a great extent the sales price and, indirectly, the potential profit or loss for a job.

There is an established procedure for handling inquiries and propositions, however the procedure is subject to wide variations depending on the exigency of the moment. Conversation with various Engineering Department personnel indicated the established procedure could not even be called normal. Work on a proposition is many times undertaken based on a memo, telephone call, or personal contact. The background information supplied covers a range from the very vaguest to a fairly detailed set of engineering specifications. When requested by the Estimating Department, the preliminary specifications, drawings, and estimated total engineering man-hours required are sent to Estimating in the proposition file. The amount of information supplied depends on the characteristics of the equipment to be produced and its similarity to jobs previously accomplished. The only record of propositions maintained in the Engineering Department is a file card containing the proposition number, customer's name, title, drawing number if applicable, and the dates received and completed.

Usually there is a considerable passage of time between the preparation of the proposition and the receipt of the job order. Due to this passage of time and the method of

accumulating and filing the information, it is very difficult to re-examine the original estimates of engineering man-hours and preliminary specifications. Therefore, as the job progresses, there is no reliable standard against which performcan be compared. There are times when Engineering produces designs that have not been considered in preparing the proposition.

A report which indicates estimated and actual engineering man-hours is prepared for Top Management on current jobs, but the figures contained therein are not applicable as a standard. We submit they are not applicable as a standard, because the estimated figures utilized in the report have been adjusted in one manner or another for costing purposes and are not sufficiently detailed for control purposes.

In an attempt to correlate the absence of a standard with engineering performance in the past, a random sample of jobs completed over the past three years was taken from the records maintained by the Cost Control Auditor and checked against the proposition files. The results are tabulated in figure 4-1. No attempt was made to analyze the sample statistically because of the uncertainty of the origin of the figures in the estimated columns. The investigation indicated that the records presently available are not a sound basis for appraisal of engineering performance.

It is recognized that forecasting results in this area is subject to many variables, some of which are uncontrollable. However, it is our opinion that by accumulating data on estimated man-hours and actual man-hours by job and analyzing the differences, the variables can be isolated and a norm based on elemental work functions can be established. We submit the minimum usable figures would be a break-down of the estimated engineering man-hours by times for consultations, design-calculations, checking and drawing. Establishment of a standard for engineering estimates should be considered separately from costing and pricing problems. Although the objectives are interrelated, the objective treated in this discussion is one of increased productivity, to be accomplished by isolating and controlling the work-task variables.

Based on the observations as stated, it is recommended that the procedure for handling inquiries and propo-

Job No.	Company	Description	Compl. Date	Prop. File Est. (Hrs.)	Reported Est. (Hrs.)	Reported Act. (Hrs.)
7524	Brownsville Board	Rebuild Dryer	4/55	*	114	227½
7412	Buckeye Cotton	Vacuum Washer	4/55	*	54½	74-3/4
7394	Camp Mfg.	14" SR Corner Drive	4/55	*	45½	20
7450	Empaque De Corton	Dist. Rolls	12/55	*	102½	37½
7448	Empaque De Corton	Felt Stretch	9/55	*	20	31½
7127	Buckeye Cellulose	Rider Rolls	6/55	*	20	34
7614	Shree Gopal	Fourdrinier	5/56	*	177	962½
7668	Flintkote Co.	Mach. Rebuild	5/56	*	273	575
7904-10	Stevens & Thompson	Layout Mach.	11/56	700	1,312½	1,493½
7768	Hamersly Mfg.	Size Press Sect.	10/56	174	174	219½
8078-84	Beloit	Drives	12/56	*	376	458½
---	Maldonado	Fourdrinier	11/57	2,977	3,339¼	3,563
---	Empaque	#1 Board Mach.Rebuild	3/58	1,875	2,523	4,129¼
---	Golden Fleece	Tissue Mach.	3/58	2,640	2,871½	1,749
---	Empaque	#3 Board Mach.	12/57	5,541	5,510¼	9,048¼

* Figures Not Available.

FIGURE 4-1

sitions be reviewed, modified as necessary, established as a standard operating procedure and utilized as a working fact. It is further recommended that Engineering prepare specifications and estimates, as detailed as necessary to permit proper appraisal by Estimating and Manufacturing, on all but the most routine jobs. Attention is invited to the comments and recommendations contained in Section 6.3.

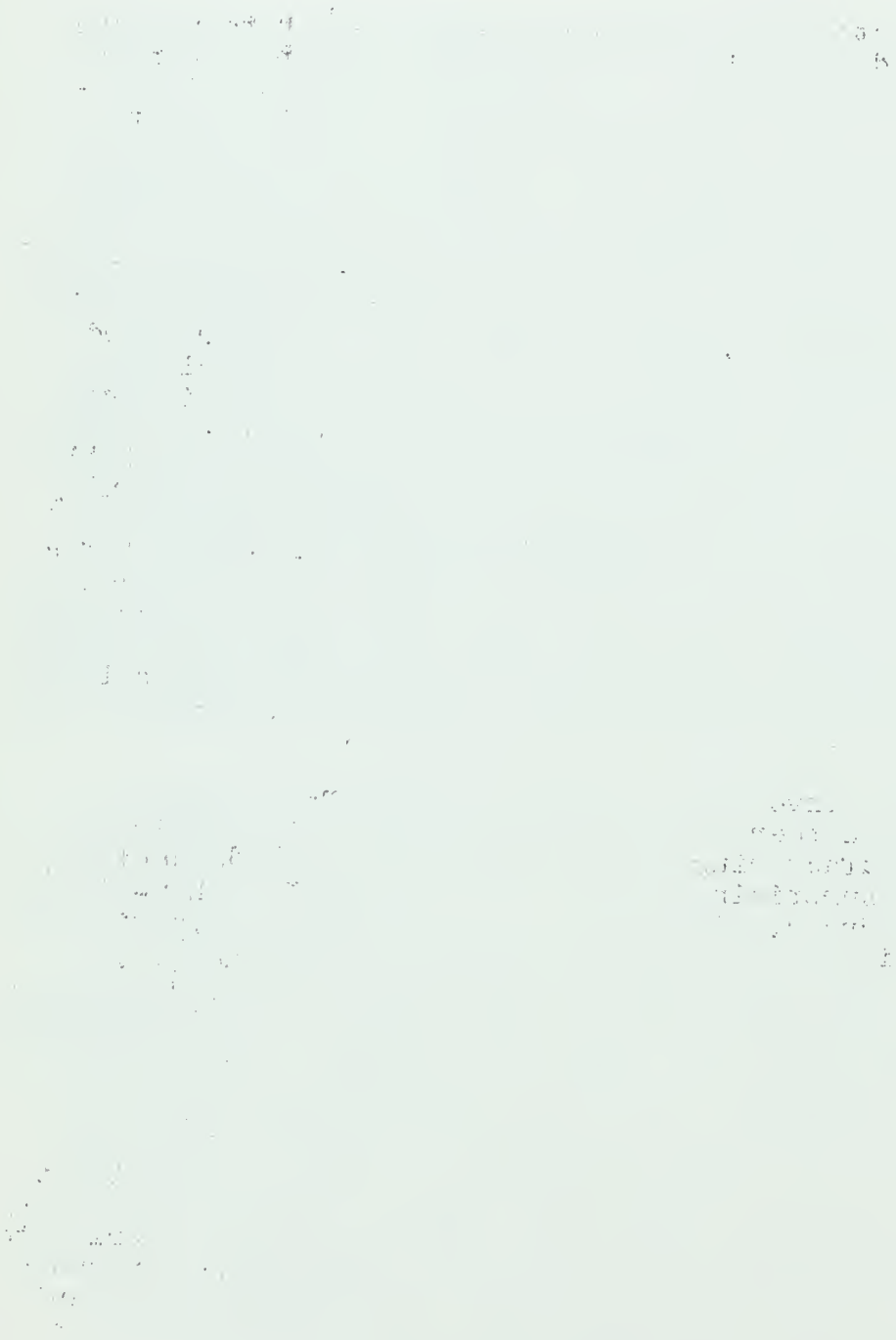
4.3 Job Orders. This area is equally as important as the one of inquiries and propositions. It is in this area that the commitment is substantiated by production. Assuming that the proposition was soundly prepared, there are many other factors that can detrimentally affect the fulfillment of the commitment, not the least of which is the engineering contribution.

Job orders are handled more systematically than inquiries and propositions, but still the established procedure is subject to many variations. In our opinion, the variations are almost completely attributable to the company-wide philosophy of informal, as opposed to formal, lines of authority. It is the introduction of orders, information, and recommendations into the Department in other than the established manner that causes the greatest disruption of organized effort. However, from the receipt of the job order folder from the Order Department, to the delivery of the finished drawings to manufacturing, there is evidence of a more ordered routine than was evident in the area of inquiries and propositions.

With the concurrence of the Chief Engineer, the administrative Assistant Chief Engineer plans the accomplishment of the job. He designates the project engineer responsible for the job and assigns the other personnel. Depending on the complexity of the job, the amount of information available in the proposition folder, and the definiteness of the contract specification, a planning conference with the project engineer may be held. The Assistant Chief Engineer schedules the progress of the job based on the engineering factors, the present work load, and the promised delivery date. Scheduling work of a creative nature is difficult even under the most favorable conditions and scheduling conditions at Sandy Hill did not seem to be favorable. Delivery dates are generally based on the current and projected load factors, but priorities

are often dictated by customer demands rather than sound planning, and deviations from the schedule are the rule rather than the exception. The sample discussed in Section 6.2 indicates a lack of organized effort to meet delivery dates. We do not mean to imply that the schedule can, or should be a static one. However, we submit that schedule deviations which are subject to control should be the result of sound Management decisions based on the economic factors involved. The value of goodwill and customer service in the case of the rush job must be weighed against the loss of goodwill, loss of productive man-hours, and frustration factors consequential to the continual interruption of scheduled jobs. We recommend that Engineering promulgate to Manufacturing, Sales, and the Vice-President for Engineering the estimated engineering phase completion dates for all job orders and that job orders subsequently received be given priority after the previously scheduled jobs, unless directed otherwise by the Vice-President for Engineering. Job order conflicts that have to be resolved at the Vice-President level should be rare if, in accordance with company policy, sound planning and coordination between Engineering, Sales, and Manufacturing have been exercised prior to setting a delivery date. Section 5.3 discusses the desirability of such a planning function.

Our investigation indicated there are numerous occasions when there are conflicts between the design engineer and Manufacturing, particularly the Methods section. This is not surprising in view of the number of non-standard products produced. The implications of standardization and simplification are discussed in Sections 4.4 and 4.5. Although there is evidence that contact with Manufacturing is made during the design phase, such contact is not established as a requirement prior to fixing the design. In our opinion, the conflicts between the interested departments could be reduced to a minimum if the layout drawings and corrollary calculations and specifications were submitted to a committee consisting of a top manufacturing man, a sales department representative, an engineer from Methods, and the necessary Engineering personnel. Review by such a committee prior to detailing and assembly might appear to introduce an unnecessary delay, but we think the total manufacturing time and costs would be reduced for most jobs. We recommend that such a committee be made a matter of policy and established as a requirement for approval of design.



4.4 Standardization. Conversations with management, the engineers, and the production personnel indicate that the word "standardization" has several meanings in Sandy Hill. For example, there are drawings which are called "standard drawings". These are drawings on which each dimension has been given a letter, and elsewhere on the drawing is shown a table with columns headed by these letters. When the engineer needs a part for which one of these "standard" drawings exists, he merely enters the dimensions he wants in the table. The only thing which is standard about this part is that the representation of the part is standard; the engineering department does not have to re-draw the part. There are no specifications for the numbers which the engineer enters on the drawing; he calls for the sizes he 'needs'. In the sense that "standard" means "adhering to a specification", the parts drawn as above are not "standard parts".

An example of the need for standardization is the Corner Drive. The corner drive is basically a piece of 8-inch standard pipe with a plate inside each end supporting a journal. There are five basic dimensions; the length of pipe, the length of shaft, the diameter of shaft and the lengths of shaft forming the journals at each end. From the methods department we obtained data on the corner drives manufactured in the past and it revealed the various sizes of corner drives which have been called for by engineering drawings. There are 37 different drawing numbers in the list. Now, if Engineering had had what is presently termed a "standard drawing" for this part, there would be one drawing number and 37 groups of entries in the table of dimensions. What would happen if there were to be "Sandy Hill Standard Corner Drives"? Engineering would examine the requirements for corner drives. They would strive to specify the minimum number of sizes to meet all normal requirements. The first question would be, "Can we do without it?" If the answer were no, the next question would be, "What is the best way to meet the need?" After designing the best solution to this engineering problem the next question would be, "Can we use one size?" Finally, having decided the minimum number of sizes, these sizes would be specified and adopted as Sandy Hill Standards and the engineers would be required to use the standard sizes. There would be savings in time, materials and manpower all the way down the line, not just in Engineering.

In arriving at standard sizes to cover a range of requirements, consideration should be given to using "preferred numbers". (See Conway, "Simplification by Selection.) Briefly, the idea behind preferred numbers is to consider the requirements for the item when selecting sizes. For example, in selecting a series of circles one would consider whether it was a range of circumferences or areas one wished to cover; in each case, the selection of increments in size would be different. In selecting a series of lengths of the corner drive discussed above, to cover the range from 7 to 36 inches, it would be a mistake to arbitrarily choose equal linear increments without considering the underlying reasons of the need for increased length.

Another example of the meaning of standardization is associated with the "flange". There are many flanges on the various parts manufactured at Sandy Hill. We examined the original drawings of flanges which were assigned separate drawing numbers during the period 7/30/57 through 9/11/57. For the purposes of this survey, a "flange" was defined as any round piece cut from a flat sheet and having an inside diameter, an outside diameter, and bolt holes around the periphery. Square flanges and specially shaped cast flanges were not counted (although one should question the necessity for any 'special' shapes). The following are the results of this sample:

Size Drawings	Number of Drawings	Number of Flanges
#4	300	27
#3	200	7
#2	187	22
#1	81	4
Total	768	60

This is merely a very simple illustration of the type of thinking which we mean to imply by the word "standardization". In a little over 5 weeks, engineering called out 60 different sizes of flanges and went to the effort of drawing Size #4 detail drawings of each of 27 different types. IF there were Sandy Hill Standard flanges, the possibility is that engineering could call them out from stock and there would be savings of engineering drawing time, clerical time,

drawing reproduction and filing time, methods and estimating time, and manufacturing time.

Suppose a study of the flange requirements revealed the need for two flanges which were identical except for the number of bolts required. Before deciding to make two, it would be well to weigh the advantages of having but one flange to make and stock to meet both requirements, even though in one application it would have more bolts than required. The cost of added clerical work and inventory to carry two flange instead of one might outweigh the saving of bolts. (See NICB, "Industrial Standardization".)

4.5 Simplification. Specifying a few specific sizes of corner drives would be standardization. Changing the design of the corner drive to meet the need for such a part in the simplest and most economical way would be simplification. What is the measure of "simplest"? Cost - with all the variables implied in that word. Assuming the part is designed to function and to sell, the elements of manufacturing cost are labor and materials. The simplest part does not necessarily use the least or cheapest acceptable material since it is the sum of labor and material cost which is to be minimized. Included in the labor costs are all of the elements of labor which vary with the complexity of the part even after it is standardized; this includes labor from ordering and handling raw materials through manufacturing to assembly and shipping. There are many solutions to any engineering problem, and a complex solution is the easiest; it takes a high degree of engineering sophistication to design a simple solution.

4.6 Classification. As each new drawing is prepared, numbers are assigned in Engineering in numerical sequence, one sequence for each size of drawing. The number assigned bears no relationship whatsoever to the part drawn. The only way anyone can find a drawing of a particular part is to know the drawing number. It is impossible to go to the files and pull out all the drawings of a particular part without knowing beforehand the numbers. For example, when an engineer comes to a section of the machine where he needs a corner drive, it is almost impossible for him to go to the files and examine the drawings of corner drives which already exist. It is easier and quicker

(for him) to make a new drawing. Engineering is aware of this problem and is presently in the process of preparing a Kardex file of drawing numbers arranged by type of assembly. A development project was approved recently authorizing another 1040 man hours to continue the preparation of this Kardex. We submit that this is really an attack on a larger problem. The Kardex will help the engineers refer to the drawing files, but it will have no effect on the manufacturing process. Current literature such as the Industrial Engineering Handbook states that classification must precede standardization. "Information systems in Documentation" is a summary of presentations made at a recent conference on information retrieval. There are many systems of classification used in industry today, and we would not presume to recommend a particular system, but we do recommend considering designing and adopting a classification system which would embrace every material and activity in Sandy Hill. This ties in with a program of standardization and simplification. In order to standardize raw materials, for example, you must know what is used; you cannot know what is used unless you classify.

There are two psychological factors effecting engineers which should be recognized. One is the engineer's pride in creation, and the other is his fear of engineering himself out of work. We submit that it is natural for an engineer to want to solve a problem his own way. The file of drawings represent other engineers' solutions. Any program to solve a problem once, and then always use that solution, can appear to be a program to restrict the engineer's scope.

If the ultimate aim is to use all standard parts, won't this eventually eliminate the need for engineers? This is a logical question, but we feel that the answer is most emphatically NO! To draw a new part when a standard part will do the job is a waste of engineering time which should be applied to developing new processes, new machines, and simpler, better ways of solving old problems.

We submit that a successful simplification and standardization program must recognize these two sources of resistance to change.

Finally, we submit that simplification and standardization just like any other program must start at the top.

Engineering specifies what to make; therefore, engineering must standardize and simplify, BUT this will only come about if top management really wants it. At all levels in Sandy Hill we heard the following sentiment expressed with pride:

"Everything we make is different."

We say that this may be true, and it most certainly will continue to be true until top management begins asking why. All of the industries using automatic equipment to manufacture standard parts today, said yesterday, that their businesses were "different" and couldn't be standardized. The firms which clung to this philosophy died.

4.7 Errors. It is standard practice in the Engineering Department to check all drawings. When a job is completed and ready to go to the shop for production, one copy of each drawing is made and then copies are given to an engineer other than the one who drew the originals. This checker goes over all the drawings as though he were making the originals; he does everything the engineer and draftsman did except draw the lines. The philosophy underlying this checking is, "Any error is bad" and, "It is cheaper to catch a mistake here on the board than to correct it in the shop". These were the phrases used by the engineering personnel interviewed. In February 1954 a survey was made of the engineering practices. This was a survey sponsored by top management with the stated purpose to, "Find reasons for, and offer measures that will prevent recurrence of engineering mistakes". We think that errors in engineering drawings can be viewed in the same way as defects in a manufacturing process and that drawing checking is analogous to product inspection. The cost of inspection should be weighed against the cost of undetected errors and their probabilities.

The senior engineers at Sandy Hill guessed that between 5% and 25% of the engineering time was spent checking drawings. Considering only salary expense, this means that Sandy Hill spent between $15,000 and $75,000 in 1957 to check drawings. This should be compared with the expense which was avoided by checking. This comparison is impossible for two big reasons: First, the draftsmen all know that their work will be checked; who can say how many errors would have been

made if they had known their work would go to the shop and they would be responsible for the consequences of an error? Secondly, many of the corrections to drawings are matters of opinion. That is, the checker disagrees with the way in which a detail draftsman has solved a problem. For example, the checker changes the tolerances on a journal because, "The manufacturer of the bearing won't guarantee it unless the tolerances are as he specified". The natural question is, why didn't the detail draftsman know the standard tolerances? This little change caused pyramiding changes in dimensions. Specifying standards within the Engineering department should eliminate differences of opinion at the detail stage. Awareness of responsibility for their own errors should eliminate many errors by the detail draftsman, and would certainly lead to their asking questions before drawing, instead of drawing first, for the checker to correct later if it is wrong.

We suggest that the policy for checking drawings could be analyzed and a system devised which would lead to overall savings. Not so long ago, 100% inspection was accepted as the only means of achieving quality control on a production line. Today, statistical quality control is the accepted means, and 100% inspection is used only in special circumstances. It appears to us that the symbols which constitute the drawings of the engineering department could be viewed as the output of a "production line". Each symbol such as line, number, finish mark, word on bill of material, etc. could be viewed as a "part" on a production line, and in the same way that parts on production lines are inspected by sampling, so too could these "parts" in the engineering department be inspected by sampling. (See Duncan, "Quality Control and Industrial Statistics" and Vance, "Statistical Sampling for Auditors and Accountants".) We think Sandy Hill should proceed to study the problem by collecting data which would reveal the categories of errors which actually occurred and the estimated costs of discovering those errors, either in the drawing room, or in the shop if the drawings had gone through unchecked. A familiarity with statistical methods would be essential prior to undertaking the collection of data. Based on this preliminary study and data, a plan for gradual introduction of statistical quality control of engineering drawings could be formulated. Ultimately the checking policy might take the following form:

"_____ (specified) symbols on _____ (specified) drawings will be inspected 100%; _____ symbols will be inspected by sampling; and _____ symbols will not be checked."

In putting this system into practice, precautions would be necessary to insure standard procedures which would minimize the consequences of error. For example, a dangerous type of error which can be made under the present system is to call for "C.I." in the bill of materials when "CI40" is required. Under the present shop practice, the lowest grade of CI is used unless a higher grade is specified. The type of error in this example would lead to use of metal of lower strength than required, with attendant possibilities of premature failure in service. To minimize the consequences of this type of error, consideration should be given to changing shop procedure so that the highest grade of metal is used unless otherwise specified. This particular example is intended to illustrate the philosophy of "fail-safe", which should underlie standard procedures. The types of errors and the consequences should be analyzed, and standard procedures adopted, so that an error which could get into the finished product, will increase the margin of safety.

4.8 Research and Development. The term research and development covers a broad range of endeavor. It is difficult to find a universally accepted definition of the term. It is generally recognized that the term in its broadest sense extends from a search for fundamental truths of nature, to applications of known principles to the solution of a specific problem. Some leaders of industry believe that their very existence depends on some form of research and development. Private industry in the U. S. spent $3.7 billion dollars during 1953 on research and development. Thirty percent of the machine manufacturing companies the size of Sandy Hill conducted R&D programs. They spent, on the average, 1.2% of their Sales dollar for research and development. (See National Science Foundation, "Science and Engineering in American Industry".) The smaller companies usually direct their efforts to the applied research and development area. They are basically interested in improving the quality, the serviceability, the performance, and the manufacturing process of the product.

In our interviews with the Engineering personnel, we learned that Sandy Hill is aware of the potential worth of effort expended in this area. However, it also appeared, that except for a recent management meeting, there has been no planned program in effect. There have been orders for machines, never before manufactured at Sandy Hill, part of the cost of which has been borne by development. In our opinion, past considerations for development were mainly of a product pricing nature. The development account was used to absorb the additional costs of engineering and manufacturing in order that the company could be competitive in its price. It is true some companies capitalize their development costs, but costing a product is not their primary aim in doing development work. Their primary aim is to maintain, or better, their competitive position by producing a more saleable product.

Inherently, research and development requires a flexible, and sometimes lengthy, schedule. As one progresses toward the research end of the spectrum, even the degree of success of a project is difficult to predict or assess. This does not mean R&D is uncontrollable. It does point up the need for a well planned program. We submit that a well planned program should include a statement of the objectives, a sound organization, a technical program approved by top management, an annual budget, and a system for reviewing periodic progress and accounting reports.

A statement of objectives and an approved technical program will provide guidance for the R&D personnel in directing their efforts toward areas of management interest. Such direction is particularly helpful in projects that produce diverging paths of inquiry.

In Chapter I, we proposed that engineers be placed directly under the Chief Development Engineer. One of the premises upon which this proposal is based is that development work should not be subject to the pressures of day by day problems. If development work is allowed to lag under the pressure of a high level of business activity, the projects that conceivably could lead to a successful product would not be completed to stimulate business during periods of reduced activity.

A budget and review of periodic progress and accounting reports are the basis for one form of control of the research and development program. Standards for appraising performance in this area are difficult to specify. Most companies rely on sound judgment to appraise the performance and use a budget based on a percentage of sales dollars as a guide.

Based on the observations as stated, it is recommended that a planned development program be undertaken on a continuing basis and that the program be reviewed by top management at least annually.

4.9 Recommendations. We recommend the Engineering Department:

1. Maintain in its files a record of the estimated engineering man-hours submitted on all propositions and when sufficient figures are available for analysis, establish standards for engineering estimates.

2. Provide Estimating with engineering estimates on all propositions except those for the most routine jobs.

3. Reduce to a minimum the deviations from standard procedure for handling inquiries, propositions, and orders.

4. Coordinate with the Manufacturing Planning Section the engineering phase completion dates for all jobs and that the priority of scheduled jobs not be reassigned without the approval of the Vice-President for Engineering.

5. Design and adopt a classification system which would embrace all manufacturing materials and activities in the Company.

6. Study the problem of detecting engineering drawing and specification errors by a statistical sampling technique and to so adopt such a procedure when feasible.

7. In coordination with representatives from the Sales and Manufacturing departments, require review of all new designs prior to fixing design specifications.

CHAPTER V - MANUFACTURING

5.1 Introduction and General Description.

5.11 Facilities and Equipment. The manufacturing facilities of the company are arranged in essentially a functional grouping, physically divided into the following areas: foundry, pattern shop, blacksmith shop, machine shop, carpenter shop, and welding shop; a space called the screen room and portions of the machine and welding shops are used as assembly spaces. The layout of these areas is depicted in Figure 5-1, which shows the ground plan of the entire plant. Not shown on the plan are several offices, including that of the plant manager, located on a mezzanine along one-third of the north-east wall of the machine shop; offices, engineering, and drafting rooms on the upper floors of the office building; and the pattern shop and storage, on a floor above the "screen and pattern room" and "patterns and stock" areas.

5.111 Foundry. The foundry proper consists of a pouring floor about 80' x 150', the middle half of which is served the full length by two traveling overhead bridge cranes, one 30-ton and one 10-ton capacity. Two cupolas are centrally located on the north-west side of the foundry, and are manually charged from a mezzanine which opens on the yard; iron and other materials for the charge are raised to this platform by a portable crane. One cupola is 60 inches inside diameter and has a capacity of 11 tons per hour; the other, 42 inches inside diameter, has a capacity of 7 tons per hour. The size of casting which can be made is limited not only by the crane capacity but also by the overhead clearance of 220 inches from the to-blocked crane hook to the floor, yielding a maximum casting length of about 208 inches and a finished length of about 184 inches. A gas-fired core drying oven in the south corner of the foundry is about 196 inches in height. These limitations on height and weight are determining factors in the market segment sought by the company because they prohibit manufacture of the extremely wide paper making machines used by the newsprint paper industry. Adjacent to the foundry floor proper is a small core room with core setting ovens, a

PARKING LOT

S.H.I. & B. WKS.

STEEL STORAGE

RECEIVING AREA

WELDING SHOP

STORAGE SHOP 2

LOADING PLATFORM

WELDING & ERECTION DEPT.

SH I & B. WKS

PARKING LOT

A

E

S

A L L E N S T R E E T

73.5'

SH I & B

146.2'

GATE

GATE

SW P. CO. OFFICE

101.20'

OFFICE ADDITION

OFFICE

234'

NO. 4

NO. 3

TIME OFFICE

GARAGE

WATER TOWER

SHEDS

60'

35'

BLANCHARD

SH I & B WKS.

SH I & B WKS

STANDARD WALL

GAULIN

FENCE 131'-5"

SH I & B WKS

SH I & P. W

134.4'

135'

193'

PARKING LOT

150'

FENCE

STANDARD WALL PAPER CO.

352.4'

NO. 5

MACHINE SHOP

SHOP ENTRANCE

SHOP OFFICE

BLACKSMITH SHOP

TOOL ROOM

WASH ROOM

SHOWER RM

PATTERNS & STOCK

SHOP

SCREEN & PATTERN RM

STOCK ROOM

SHOP

FOUNDRY

CORE RM

STORE SHEDS

FENCE

66.2'

ROAD

NO. 9

Charging Material Area

Elevated Charging Platform

Flask Storage Area

Coke Storage

STORE SHEDS

SAND

134'

GATE

SHED

LUMBER

SHED

86'

LOGS

CARPENTER SHOP

POWER - HEAT

GATE

FENCE

GATE

PARKING AREA

PLANT LAYOUT

FIGURE 5-1

FLANT LAYOUT

FIGURE 5-1

"brass room" for storing brass scrap and for sanding small articles, and a sanding room equipped with power tools and a new shot sander with a capacity for castings about 4'x4'x 2'.

5.112 Blacksmith Shop. The area so labeled in Figure 5-1 contains two small hand-fired coke forges, a power-driven forging hammer, and an anvil. The south corner contains a small cyanide case-hardening oven, annealing oven, oil tempering bath, quenching tank, wax dip tank, copper plating tank, and a bench lathe. The remainder of the area is principally used as a passage connecting the machine shop and the stock room or foundry, and also as a coffee issue location. The floor is approximately 90'x50', less than half of which is used for the forge shop and cyanide processing.

5.113 Pattern Shop. Patterns are made in a loft about 85'x25' located above the screen assembly room. Adjoining the pattern shop proper is a small room used as a foreman's office, and a large 90'x50' pattern storage loft. The pattern shop is equipped with a 12 inch planer, an 8 inch table saw, a wood lathe, band saw, small cross-cut saw, disc sander, drill press, and various hand tools.

5.114 Machine Shop. The machine shop is housed in a building 90 feet wide and 280 feet long. Two traveling overhead bridge cranes, capacity 15 tons and 10 tons respectively, serve a 45 foot wide central portion of the floor throughout the length of the structure. The side bays are served by various smaller bridge cranes, both electric powered and manual. Except for the fact that the large capacity machines are located in the center floor under the large cranes, with the small machines in the side bays, there is no apparent logical arrangement of the machinery in the space; it is obvious that the layout has grown piecemeal with the growth of the company, each new machine being located as dictated by the space available. A planned modification commenced in 1957 and the present layout is somewhere between the former arrangement and the proposed future arrangement. The present layout is shown in Figure 5-3. The proposed arrangement is stated to have resulted from an effort to regroup the machinery by function in order to make

MACHINES IN MACHINE SHOP

Size	HP	Manufacturer	Year	Hourly Rates	Condition
Turret Lathes 11,400*					
28"x5'	15	Gisholt	1942	8.25	Fair
19"x24"	10	J & L	1942	10.00	Good
19"x24"	10	J & L	1942	10.00	Good
Milling Machines 6,600*					
#5	50	Cincinnati V	1953	9.50	New
#4	15	Cincinnati	1941	8.25	Fair
#12	5	Brown & Sharp	1894	8.25	Poor
#3	5	Cincinnati	1921	8.50	Poor
#1	3	Cincinnati	1919	8.25	Poor
Boring Mills V 21,400* H 5,800*					
88" Vert.	30	Niles	1955	12.50	New
84" Vert.	30	Cincinnati	1942	12.50	Fair
50" Vert.	10	King	1906	8.25	Very Poor
50" Vert.	7.5	King	1905	8.25	Poor
36" V.Turret	30	Bullard	----	10.00	
5" Horiz.	15	Sellers	1941	12.50	Recently overhauled
3" Horiz.	19	Defiance	1942	8.75	
Large Engine Lathes 18,200*					
42"x280"	50	Meuser	1956	12.50	New
40"x30'	15	Lodge & Shipley	1912	8.25	Converted to Roll Straightener
65"x20'	15	Pitts.Mach.Tool	1888	8.25	Very Poor
68"x19"	15	Gleason	1888	8.25	Poor
96"x35'	25	Pond	1915	9.25	Poor

CHART 5-1

Size	HP	Manufacturer	Year	Hourly Rates	Condition
		Small Engine Lathes 6,000*			
19"x53"	7.5	Lodge & Shipley	1946	9.25	Good
21.5"x6'	5	LeBlond	1917	8.25	Poor
23"x12'	10	Lodge & Shipley	1942	9.00	Fair
25"x5'	5	Boye & Emmes	1908	8.25	Poor
26"x15'	10	Gleason	1894	8.25	Fair
28"x12'	20	Lodge & Shipley	1941	9.50	Fair
32"x26'	15	Pond	1905	8.25	Fair
		Drills 23,400*			
6' Radial	10	Dreses	1900	8.25	Poor
6' Radial	15	Carleton	1941	10.00	Fair
6' Radial	10	Cin. Bickford	1944	10.00	Fair
3' Radial	3	Cin. Bickford	1944	8.75	Good
4 Spindle	1	Delta	1943	8.25	Good
Stand Drill	1	Sibley	1946	8.25	Good
Stand Drill	1	Sibley	1946	8.25	Good
Shell Drill	5	Sandy Hill	1951	9.50	Good
Pari-Pac Dr.	5	Sandy Hill	1950	8.25	Good
		Planers			
36.5"x17'	10	Gleason	1889	8.25	Very Poor
30"x11'-8"	15	Cincinnati	1920	8.25	Fair
28"x12'	7.5	Detrick & Harvey	1909	8.25	Very Poor
28.5"x17'-4"	10	Detrick & Harvey	1909	8.25	Very Poor
		Miscellaneous 26,200(Incl. Planers)*			
Cabbage Cutter	40	Sandy Hill	1907	8.25	Fair
Slab Miller	7.5	Ingersoll	1903	8.25	Very Poor
Bolt Threader	3	Landis	1948	8.25	Good
Gear Cutter	10	G & E	1900	8.25	Very Poor
Gear Hobber	10	G & E	1947	11.25	Fair
Roll Grinder	15	Lobdell	1924	9.00	Poor
Cam Grinder	10	Landis	1920	8.25	Fair
Cam Bore Mach	5	Bridgeport	1884	8.25	Poor

CHART 5-1 (Cont'd)

Size	HP	Manufacturer	Year	Hourly Rate	Condition
		Miscellaneous (Cont'd)			
Cam Lathe	5	?	1884	8.25	Poor
Keyseater	--	Mitts & Merrill	1946	8.25	Good
Band Saw	--	Doall	----	8.25	Good
Hydr. Jack	--	Watson-Stillman	1904	7.25	Good
Surface Grndr	--	Norton	1944	8.25	Good
Hack Saw	--	Peerless	1940	8.25	Fair
Roll Jack	--	Sandy Hill	?	8.25	Fair
Shaper	--	Gould & Eberhard	1920	8.25	Good
Shaper	--	Ohio	1942	8.25	Good

* Average Annual Backlog in Hours

supervision more effective. The machines currently available are listed in Chart 5-1 showing age, condition and intended (long-range) disposition.

5.115 Carpenter Shop. The carpenter shop, a space 40'x65' adjoining the rear (north-west) end of the machine shop, opens on a lumber storage yard 80' x 250' having three sheds with about one-half million board-feet capacity. It is equipped with a 24 inch diameter belt-driven cross-cut saw, one band saw, one table saw, two 24 inch planers, a boring press, a shaper, and miscellaneous tools.

5.116 Welding Shop. The welding shop occupies portions of a storage and assembly building across the road from the main plant. The shop is equipped to do a variety of electric arc welding, brazing, silver soldering, and gas or magnesium powder burning jobs. Two automatic welding machines are installed, but are not used because of the absence of volume production to justify set-up time.

5.117 Assembly. There are three assembly or erection areas in diverse locations. The principal one occupies about 60 feet of the rear end of the machine shop and is served by the machine shop cranes. A second one shares with the welding shop all of a recent addition to a storehouse across the street (Allen Street) from the main plant. The addition is about 70 feet wide and 120 feet long and is equipped with a full span 30-ton traveling overhead bridge crane. The third assembly area, 85' x 25', is called the screen room and is located in the rear of the plant near the foundry. It is equipped with a 5-ton electric hoist and a hand chain hoist. The assembly spaces are used for inspection, repair of minor defects, balancing, assembly of parts shipped assembled, and test assembly of machines to check operation and fit before shipping.

5.12 Functional Organization. The manufacturing department is organized functionally as a job shop because of the varied nature of paper making machinery and the company policy of giving the customer whatever he asks for rather than empha-

sizing sale of standard machines. More precisely, the organization is that of two job shops sharing services and utilities, because of the independent nature of the foundry operation, as discussed in the chapter on organization. The management states that diversity is so fundamentally a part of the papermaking machinery trade that no piece, part, or assembly could be said to be a principal product, and no line production is feasible, nor even a sequential arrangement of functional groups. This will be discussed further in Section 5.2, "Products". The basic division of personnel and line supervision is, appropriately, functional, and is generally in accordance with the physical subdivision of the facilities discussed in paragraph 5.11. A tabulation of the distribution of personnel in these groups is displayed in Chart 5-2. Because of the haphazard arrangement of machine types in the machine shop, the physical subdivision by function stops at this level, and it is interesting to observe that supervisory subdivision of function also stops at this level except for the driller gang; the drills are close enough to permit supervision by a driller foreman. All other machine groups are supervised in a general way by roving foremen, and as a consequence are very weakly supervised. The deemphasis on direct supervision created by management philosophy is also indicated by the low ratio of foremen to workers in the machine shop day shift. As is shown in Section 5.5, the burden of supervision is shifted from the foremen to others. The discussion of the manufacturing process in later paragraphs will be subdivided into management functions instead of process functions, and emphasis placed on standards and controls rather than production methods. The preliminary handling of orders is discussed briefly in the next paragraph.

5.13 Background: Inquiry to Production Order. The manufacturing process begins when the master production order and bill of materials is issued by the order department. The details of this process are discussed in Section 5.3 and will not be elaborated here. Orders received by the company may be roughly categorized in two types: "day work" orders, which may be handled informally, as by telephone direct to the Shop Superintendent, and custom orders, which usually begin with an inquiry. Considering the latter only, the inquiry is referred to the estimating section where by

DISTRIBUTION OF LINE PERSONNEL*

Manufacturing Organization

Shop or Gang	No. of Workers	Direct Supervision 1st Level	2nd Level	3rd Level
Foundry	47	1)	1	
Pattern	4	1)		
Machine	83	4)	1	1
Carpenter	5	1)		
Forge	1	)		
Cyanide Treatment	1	)		
Welding	20)	1	1	
Electrical Maint.	2)			
Services	2)			
Watchmen	4)			
Erection	21)	2	1	
Painters	2)			
Material Handling and Yard and Bldg. Maint.	12)	1		
Vehicle Maint.	1)			

*Includes day and night shift workers and supervisors.

CHART 5-2

use of a set of historical data, a price adjustment table, and consultation with the engineering department, a price figure and date of completion is provided to the customer. Upon receipt of the customer's order, the Engineering Department commences the necessary final design work, advising Purchasing of any unusual subcontracting or materials requirements. Then a bill of materials is prepared and sent to the order department along with the drawings of the pi ces to be manufactured or subcontracted. Before issue of the bill of materials and shop production order, a check is made of the inventory records to see what raw material and stock is on hand, and the order is modified accordingly. A detailed discussion of the flow of the production order and associated papers from the moment of issue of the order to the manufacturing department is contained in Section 5.3.

5.2 Products.

5.21 General Investigation. In order to study and appraise the various aspects of management of the manufacturing activity of this company on a sound basis, specific information is required as to what major items are produced, what components or sub-assemblies are included as the essential elements of the major items, and what miscellaneous items are manufactured or processed through one or more of the shops for the purpose of maintenance or repair. A general concept of the design or nature of products and knowledge of frequency of manufacture or relative amounts of shop time required plus the information provided in the preceding section pertaining to physical facilities provides necessary background for the subsequent sections of this chapter.

The major portion of company business and consequently the major manufacturing activity is production of a complete line of paper making machines (limited in roller width to approximately 184 inches), pulp preparation equipment, replacement parts, and performance of repairs or rework. A small amount of work, varying from 0 to 10% of sales, is comprised of orders for miscellaneous items not related to the paper industry, but requiring engineering, foundry, heavy machine shop, and welding and fabrication facilities and services such as this company has available. By no means complete,

the following list and photographs provide at least a general concept of items comprising major products:

Paper Machines (for products ranging from the thinnest tissue to heavy paper board)

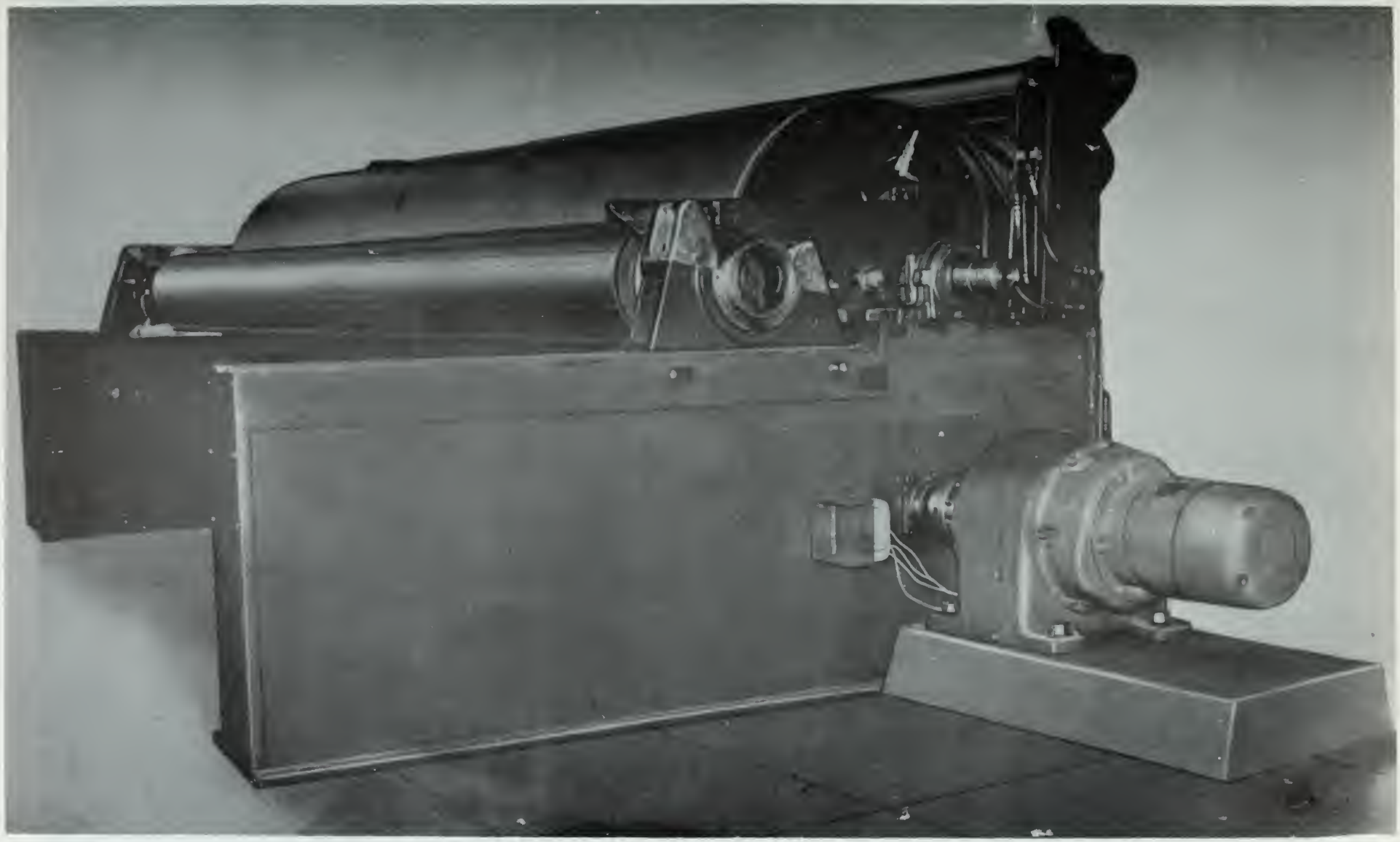
Kamyr Line of Pulp Bleaching and Pulp Preparation Equipment

Sub assemblies or related equipment:

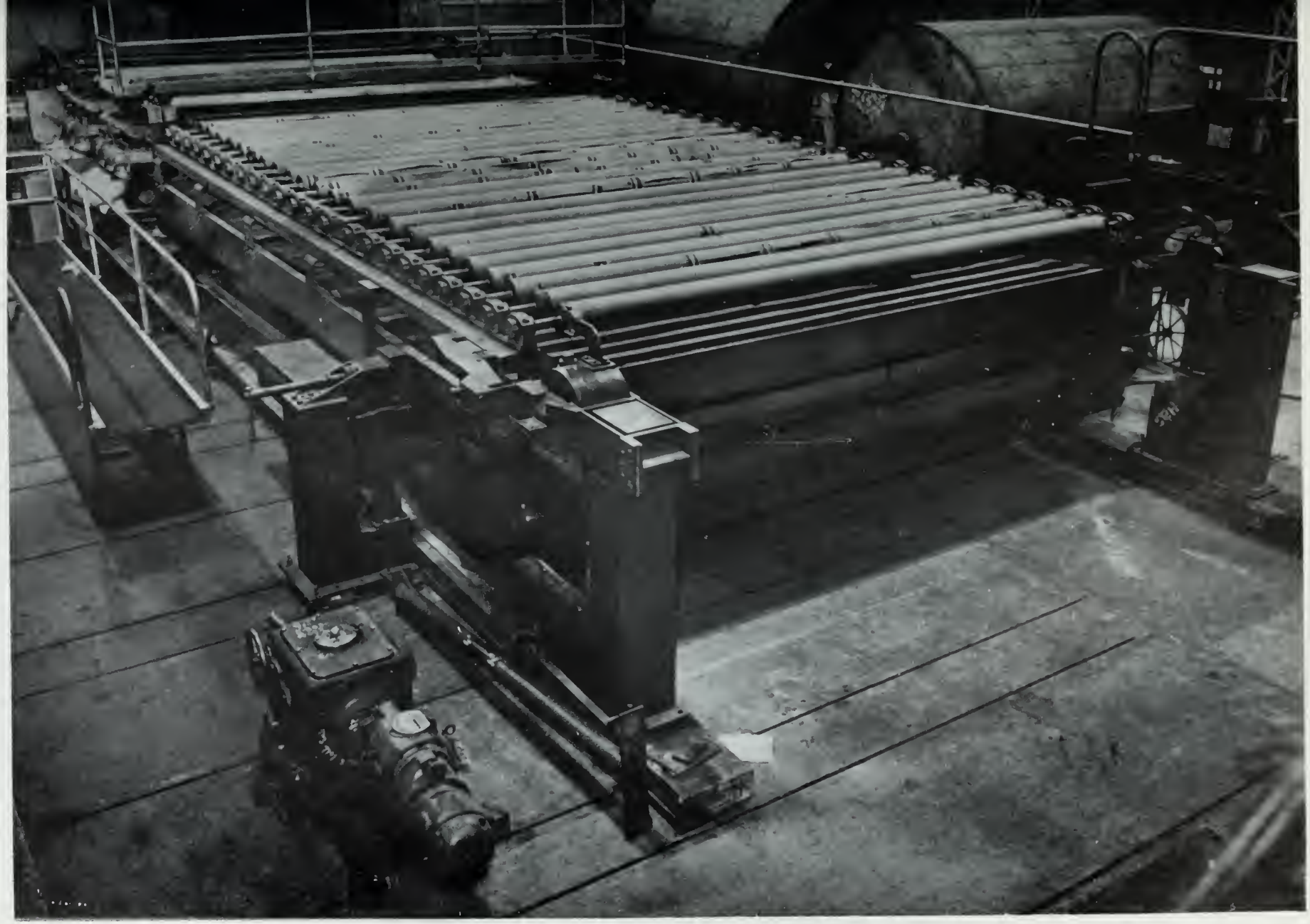
Flow control Unit
Fourdrinier or Rotoformer
Size Presses
Wet Presses
Dryer Section
Calender
Winders
Reel
Power Drives and Shafting
Rolls
Driers
Suction Boxes
Pulp Grinder
Screens
Washer
Thickener
Pumps
Bleaching Systems
Valves
Wire Conditioners
Felt Conditioners

After viewing the many detailed parts comprising the items made, it was realized that the company is engaged in the manufacture of a tremendous variety of items related, in general, to the paper making industry. The additional workload comprised of repairs to parts and sporadic manufacture of special machines not related to the paper industry simply adds to the variety. The general statement and listing of the products manufactured is included herein both as factual information of general interest and as a starting point in attempting to reveal whether or not a pattern exists

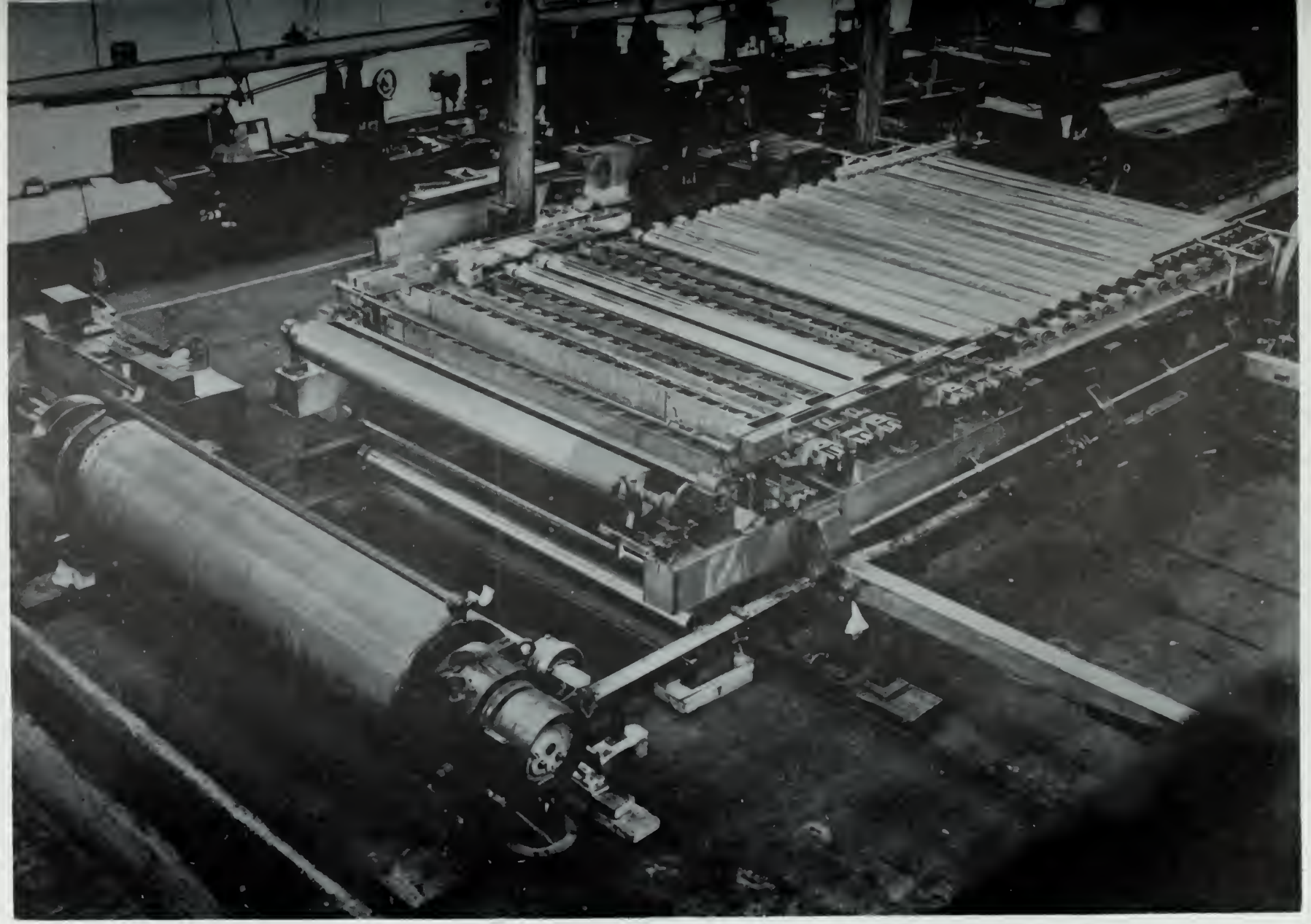
DRYER SECTION ON CONVENTIONAL SANDY HILL BOARD MACHINE



SANDY HILL HYDRAULICALLY CONTROLLED HEAVY REEL

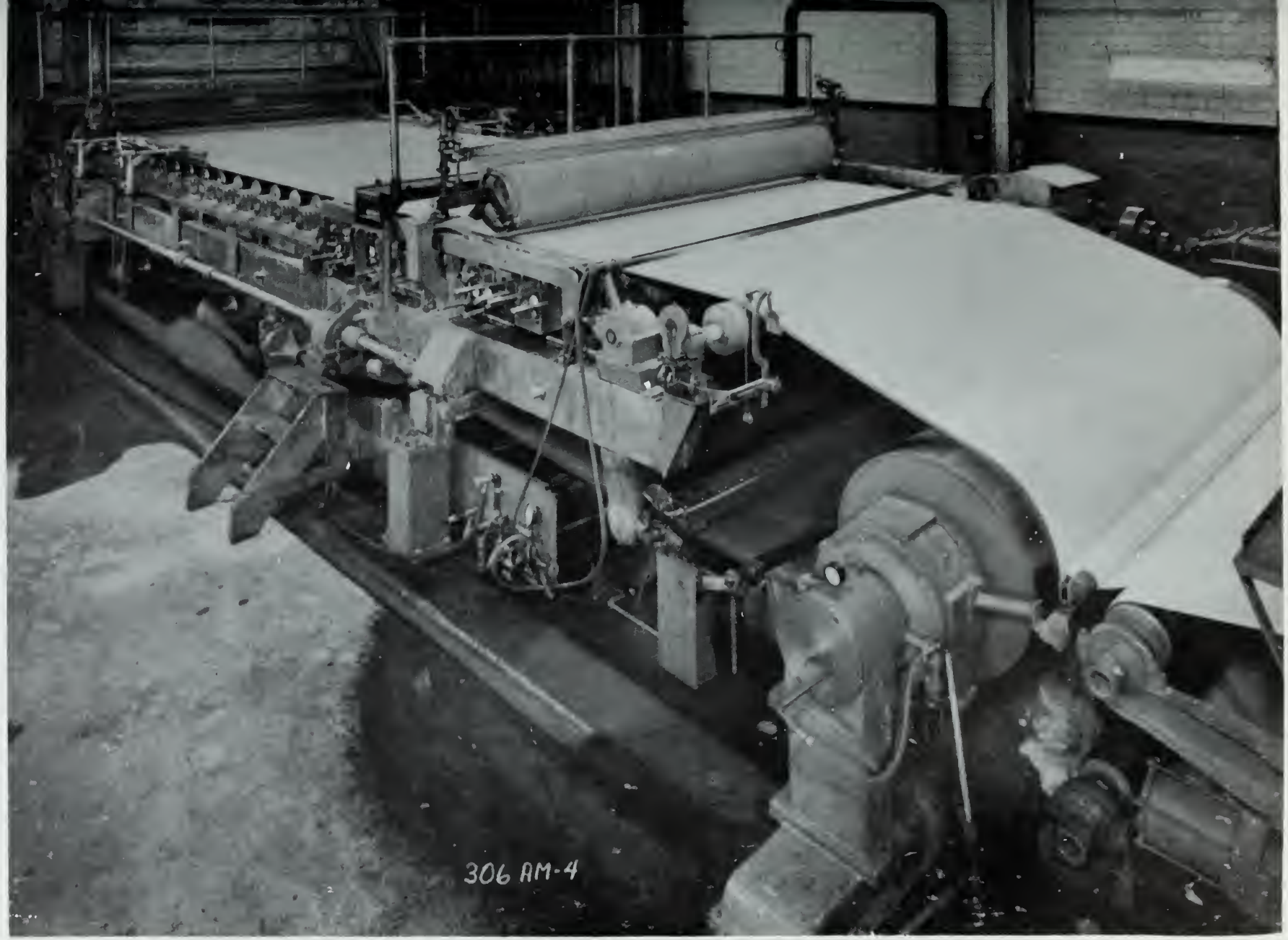


SANDY HILL FOURDRINIER

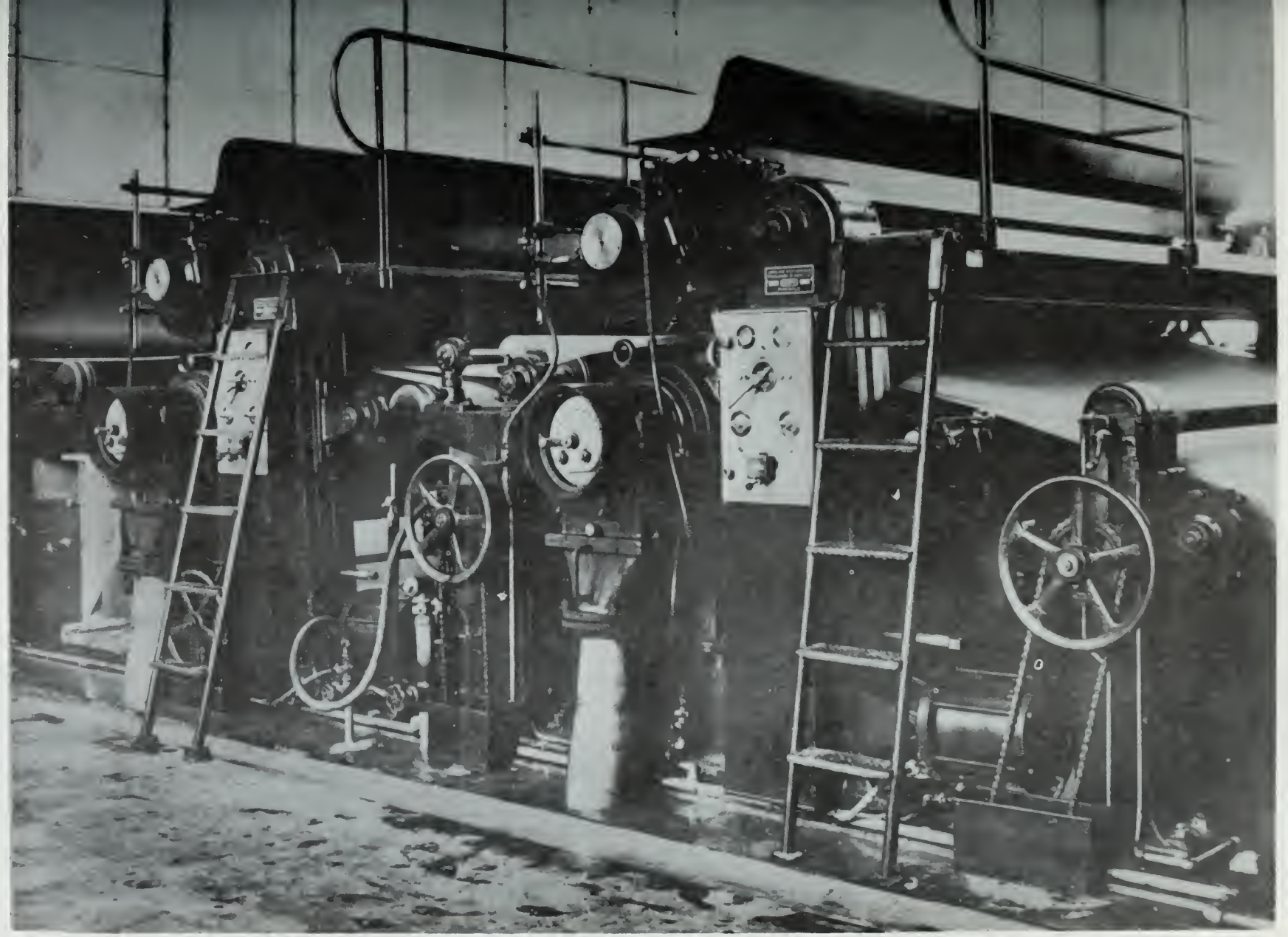


SANDY HILL REMOVABLE FOURDRINIER

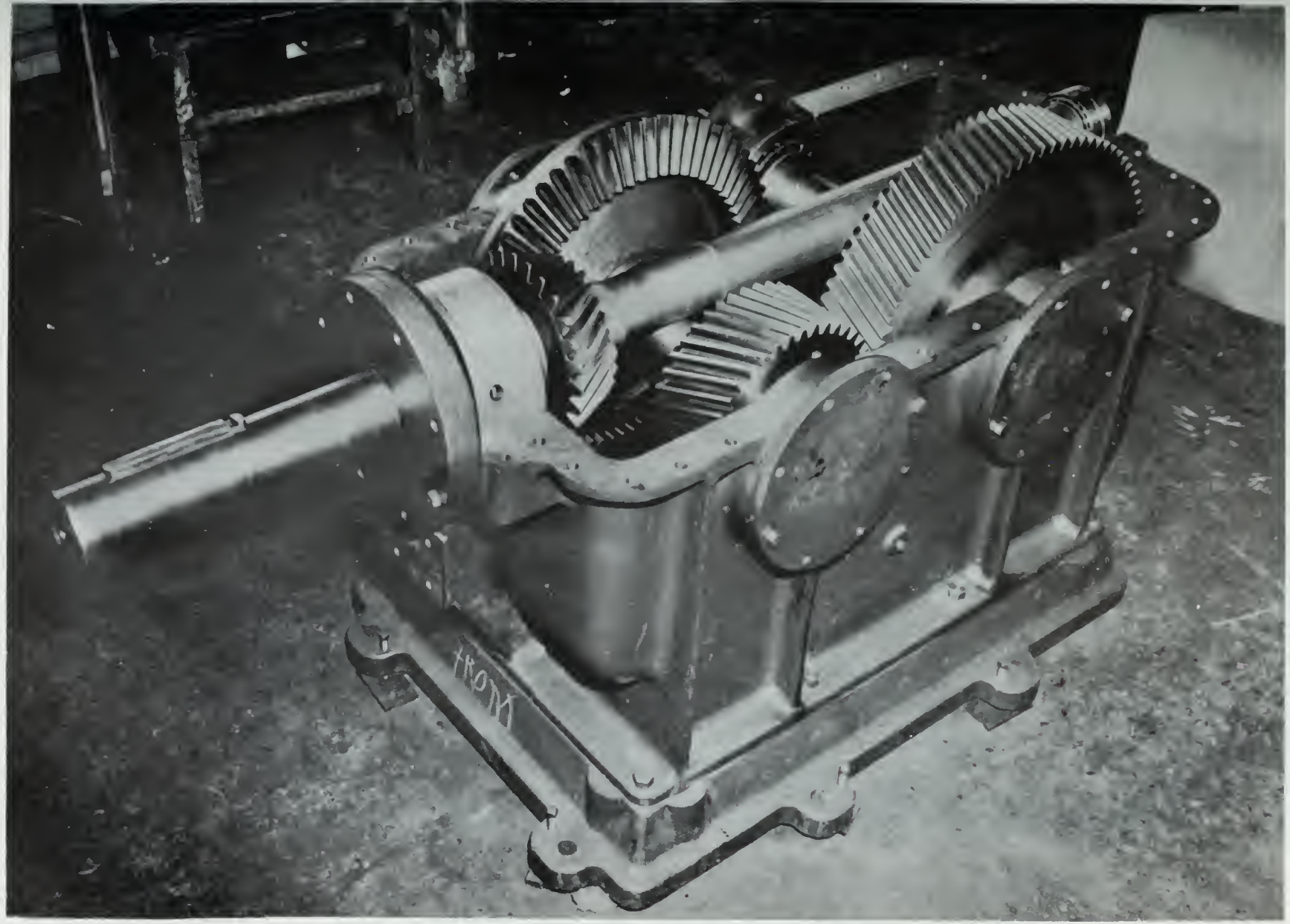
[illegible]



SANDY HILL REMOVABLE FOURDRINIER



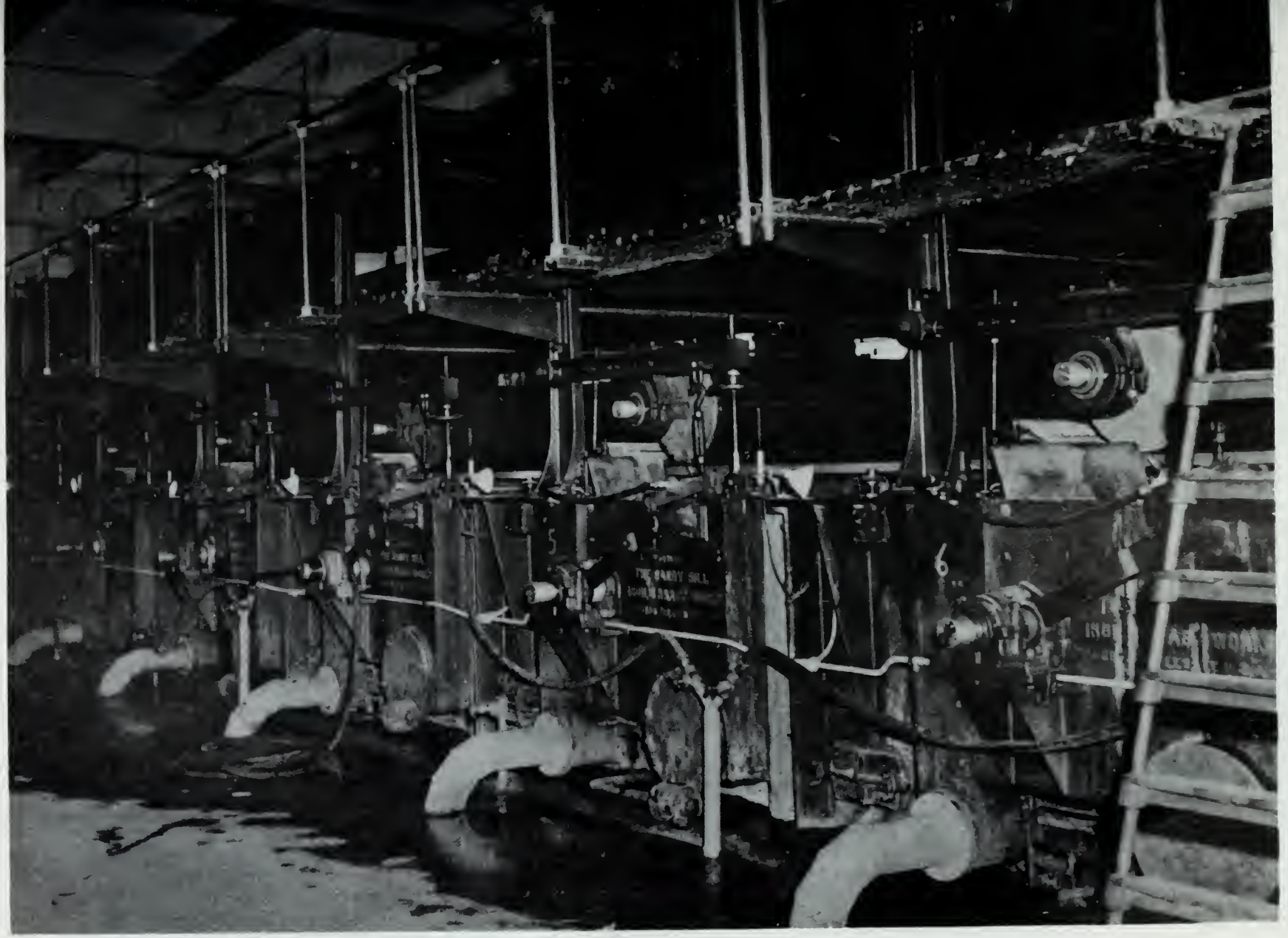
SANDY HILL PRESS SECTION



SANDY HILL DOUBLE REDUCTION GEAR BOX

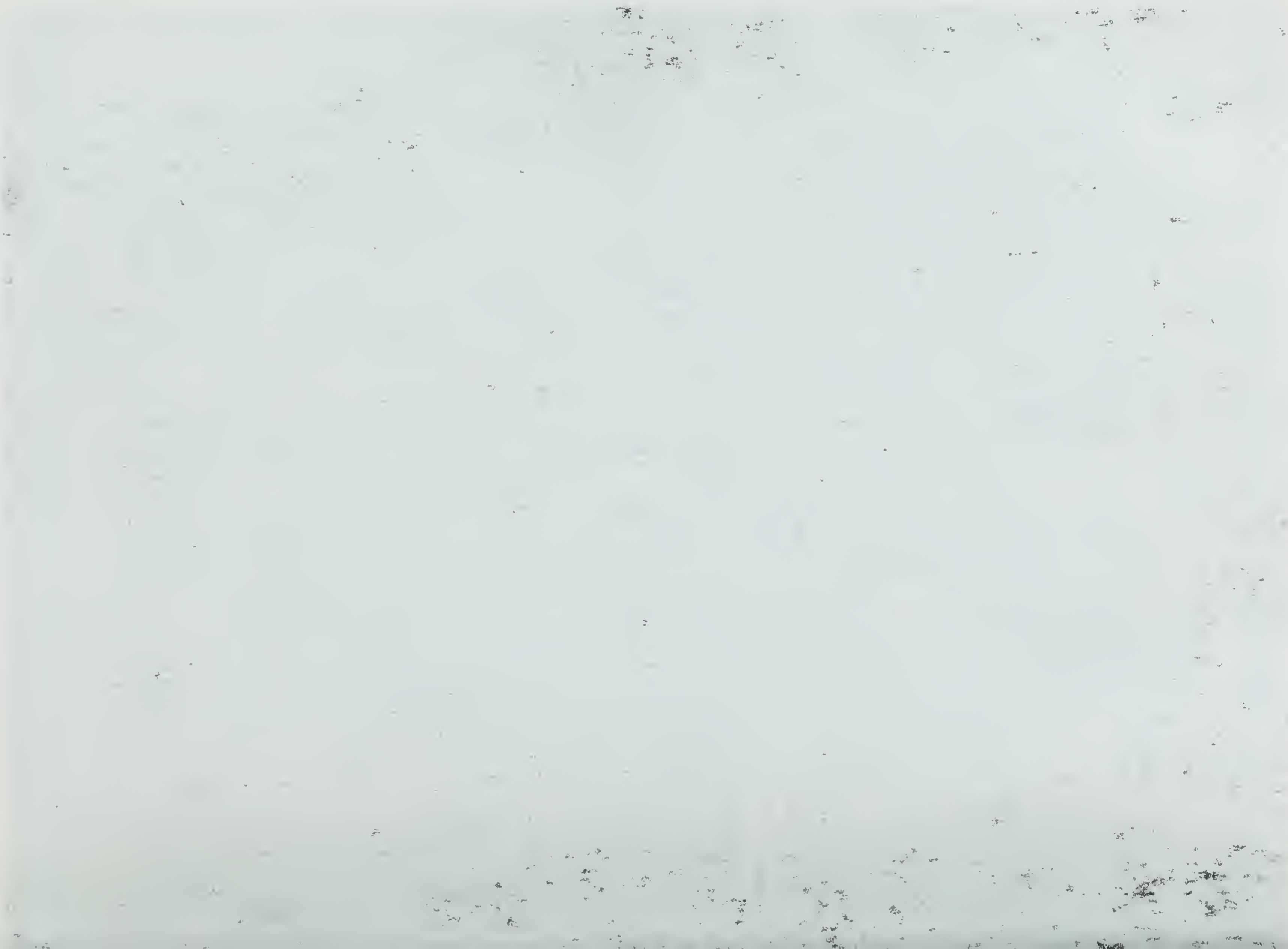
SANDY HILL STOCK TRANSPORT PUMPS

KAMYR HIGH DENSITY PUMPS

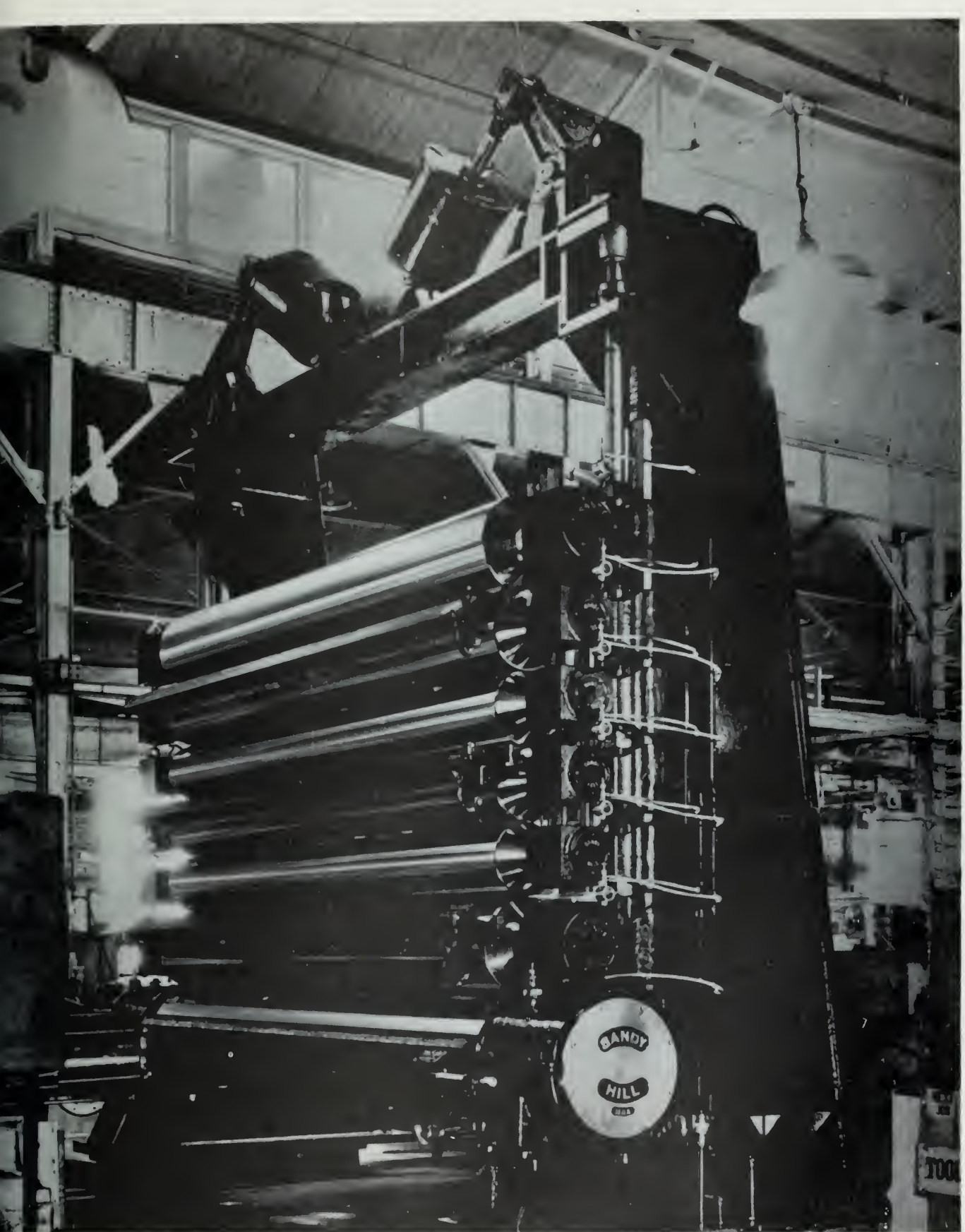


VAT SECTION ON SANDY HILL BOARD MACHINE

[illegible]



SANDY HILL SELECTIVE DRIVE



SANDY HILL OPENSIDE CALENDER STACK

SANDY HILL ROLLER SHOE PACKER SCREEN

of repetitive processes or volume production of certain items of similar or identical design. The results of such an analysis should be considered in the study and appraisal of production planning and control, shop layout and process flow, methods and standards, and general utilization of manpower and machines or equipment. During the course of discussion with personnel of the manufacturing activity in an attempt to become familiar with the many individual items made, preliminary to attempting an analysis, the following information was learned which, it was realized, would have a direct influence on the study and make most difficult, if not preclude, the development of any definite pattern of manufacturing activity.

1. The exact composition and characteristics of material used in making paper, both raw and after processing, is considered by the industry to present a broad and almost unpredictable variable which defies speficication. For this reason paper making has not been reduced to a science but is rather to considerable extent an art of the paper machine operator. The variety of types of paper and paper products and the consequent variety of designs and sizes of machines required, further compounded by detailed design peculiarities developed and demanded by the many individual paper makers generates for the Sandy Hill Iron and Brass Works a custom order type of business wherein standardization has been applied only to a small degree. In general, it appears to be company policy to cater to the customer's desires.

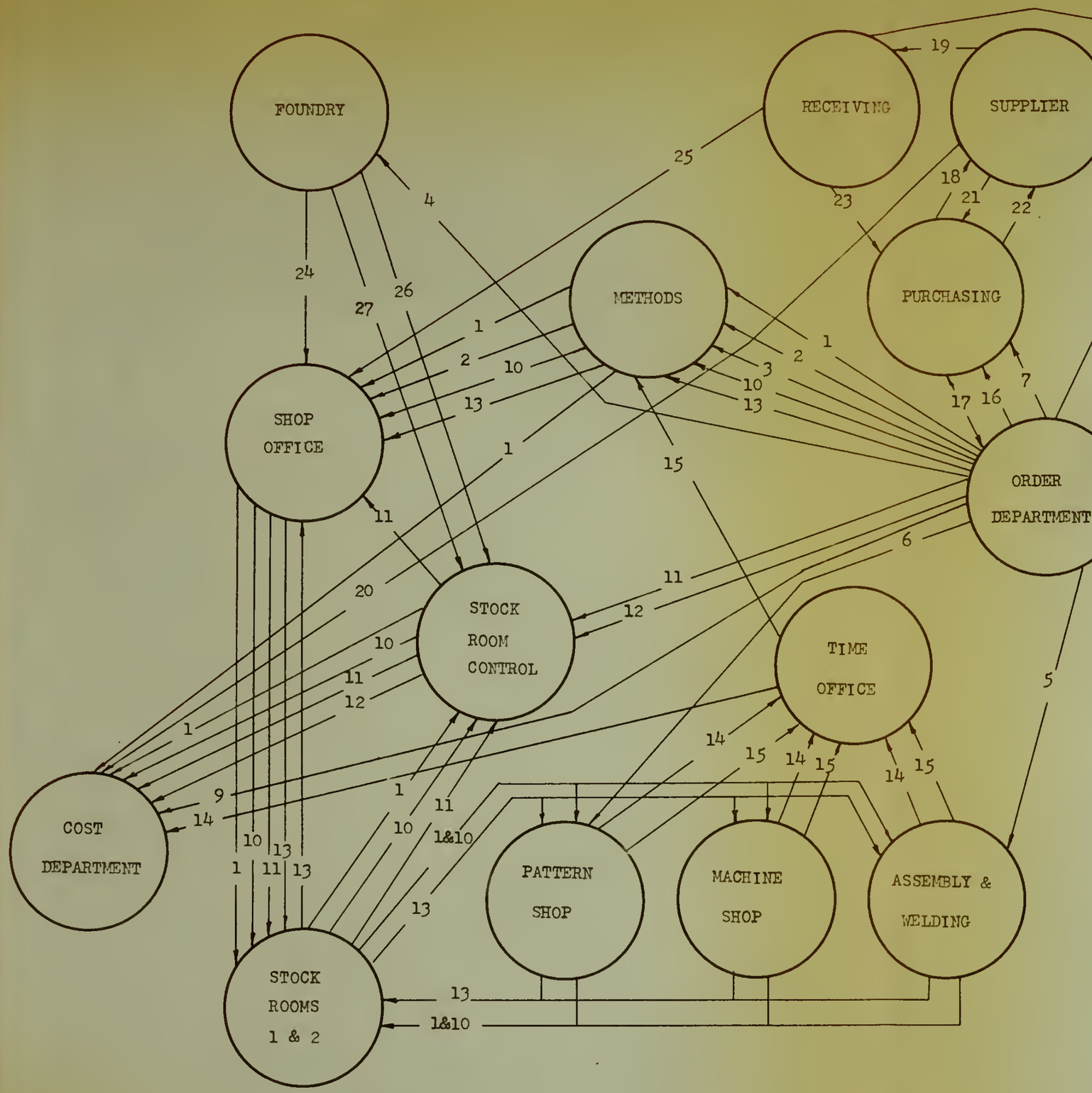
2. The general nature, frequency, and composition of customer's orders varies to such an extent that in essence the manufacturing activity is a highly variable job shop type of operation with little if any continuous activity on any one design of product.

Accepting as fact the existence of variety in design and size of parts and the constantly fluctuating composition and volume of workload, effort was concentrated on determining what parts, similar in design and undergoing similar machine processes, required a significant proportion of shop labor hours. Within the limits of time available to develop information, only a partial study was possible. Activities in paper machine manufacture and repair and rework were selected since these were reported to constitute on the

CHART 5-3

SAMPLES OF SHOP LABOR HOURS - ROLLS, DRYERS, BEARING HOUSING

Percent Sales	Product	Component Parts	Shop Labor Hours	Percent of Shop Hours	
55-60	Paper Machines:	Rolls	4,704	14	
		Dryers (38 sections)	5,236	15.6	(Ranges from 7% to 25% depending on numbers of sections)
		Bearing Housings	4,495	13.4	
		Frames	875	2.6	
		Gears (Dryer)	1,254	3.7	
		Remaining Assemblies	17,056	38.2	
		Total	33,620	100.0	
15	Rework,	Grinding	13,700	29.6	
	Repair,	Repair Roll & Dryers	2,600	5.6	
	Work Under	Under $5,000	39,100	64.8	
	$5,000	Total	46,400	100.0	
	(1957)				



1. ROUTE CARD
2. PRODUCTION ORDER (CONTROL)
3. PRODUCTION ORDER (METHODS)
4. PRODUCTION ORDER (FOUNDRY)
5. PRODUCTION ORDER (ASSEMBLY)
6. PRODUCTION ORDER (PATTERN)
7. PRODUCTION ORDER (PURCHASING)
8. PRODUCTION ORDER (ENGINEERING)
9. PRODUCTION ORDER (COST DEPT.)
10. STOCK REQUISITION (ROUGH)
11. STOCK REQUISITION (FINISHED)
12. STOCKROOM CARD
13. ENGINEERING DRAWINGS
14. TIME SLIP (ACCOUNTING)
15. TIME SLIP (METHODS)
16. REQUEST TO ORDER
17. ROUGH MASTER PRODUCTION ORDER
18. REQUEST FOR QUOTATION
19. SHIPPING INVOICE
20. BILLING
21. QUOTATION
22. ORDER FOR MATERIAL
23. MATERIAL RECEIPT NOTICE (PURCHASING)
24. MATERIAL RECEIPT NOTICE (INVENTORY)
25. MATERIAL RECEIPT NOTICE (SHOP OFFICE)
26. CAST REPORT SHEET (EACH HEAT)
27. CASTING TICKET (EACH PIECE)

WORK ORDER PROCESSING

FIGURE 5-2

average about 75% of sales dollars. Particular attention was paid to work on rolls, dryers, and bearing housings since these appear in some volume on a paper machine. Chart 5-3, a summary of some of the data studied, presents information on (1) a typical paper machine, and (2) one year's work under the general heading of Repair, Rework, and Work under $5000 per order.

5.22 Possible Improvements. Under the present conditions of variability in design detail, size of products, and workload scheduling, pre-production activity must be undesirably high in engineering design and preparation of drawings, in preparation of master shop work orders, in detailing shop methods and attempting to set standards, and in procurement of material.

Shop hours expended on rolls and dryers, while variable, appear to constitute at least 25% of total productive labor hours. It is believed that careful study would reveal other major components, such as corner drives and pumps, on which significant proportions of total shop hours are expended. It is fully recognized that the analysis made provides only a relative indication of workload proportions within a fluctuating range. It is believed, however, that such information does point to important areas on which effort might be best expended in effecting improvements in overall productivity.

It is difficult to set forth conclusions and recommendations derived solely from study of products made. In order to avoid duplication in detail of recommendations more appropriately expressed in other sections of the report, it is recommended at this point in general terms that serious study be made of the possibilities of design simplification, followed by standardization of both design and size wherever possible. It is recommended that effort along these lines be concentrated on those items which require the significant portions of shop labor hours.

5.3 Production Planning and Control.

5.31 Work Order Processing. (Figure 5-2) The manufacturing

process commences with acceptance of a customer order. The first documents pertinent to production are the engineering drawings and the associated bills of material. These define the production objectives and commit the organization to a particular sequence of actions.

Upon receipt of the blueprints and bills of material, the order section prepares copies of the production order (bill of materials) describing each component line item, the number required, pattern number, drawing number, and job order number. The order section, using the criteria of workload and facilities limitations, consults with methods, engineering, or manufacturing and decides whether an item is to be made or bought.

Copies of the production order and associated documents are distributed as follows (Numbers refer to Figure 5-2):

1. A job card or route care is prepared for each line item of material. This card is basically an operation sequencing card.

2. Control copy of production order is prepared for use of the production coordinator.

3. Methods copy of production order is retained in methods section.

4. If foundry work is involved, a copy of the production order is sent to the foundry and a copy (6) is also sent to the pattern shop.

5. Assembly copy is sent to assembly floor foreman where it becomes part of an assembly instruction book prepared for each major assembly.

7. A copy is sent to purchasing who have already checked material requirements specified on the rough copy of the master against inventory. Materials required are automatically ordered.

8. Engineering receives a copy of the production order for general information.

9. The cost department copy of the production order is used as a check-off list to ensure that charges are received on all items and are posted to the proper account.

10. A stock requisition (rough) for each line item is prepared for use by the stockroom in recording issue of material to be processed.

11. A stock requisition (finished) for each line item is prepared to record final stockroom issue of all parts (purchased or processed) for final assembly.

12. A stockroom card is prepared for each line item to record all pertinent material issues and is ultimately cross checked against the material cost card in cost accounting. This card and the stock requisition (finished) are sent direct to stockroom control.

The blueprints, control copy of production order, rough requisition, route cards, and methods department copy of the production order are sent to the methods section who complete the route card. The blueprints, control copy of production order, rough requisitions, and route cards are then forwarded to the production coordinator.

5.32 Production Control. Upon receipt by the Production Coordinator, the route cards with the attached stock requisitions (rough) are filed until they are actually issued for accomplishment.

The control copy of the production order is placed in a "book" along with other production orders pertaining to the same major assembly or contract. This "book" becomes the principal control document for the expediter who is assigned to each major assembly. Completion of an item is posted in this book which is the source of the "shortage lists" the expediter prepares periodically to pin point items still not ready for a given assembly.

The expediter actually follows the progress of the item through production. He ensures that when the production coordinator releases a route card for processing, the blueprint, requisition, route card, and the material

are available in the stockroom. The initial operator is notified of his assighment by the production coordinator or expediter and draws the route card, blueprints and material from the stockroom and commences work. When his operation is completed, he calls an inspector to pass upon the work. If the inspector approves, he initials the route card opposite the operation and the operator begins the work specified on the next assigned route card.

Upon completion of a given operation, the expediter directs the material handling or "move men" to transport the material to the next operation scheduled on the route card. The second operator completes his work, satisfies the inspector, and the material is again moved to the scene of the next operation.

When all operations are completed and the inspector has initialed and dated the route care to indicate full acceptance, the finished material, route card, and blueprint are returned to the stockroom where the material is tagged for ultimate issue to the assembly floor.

The route card then serves as completion notice to stockroom control, methods department, cost department and expediters who mark the item complete in the books of production orders.

When all items for a major assembly are completed and available, the assembly route card is issued and the stock requisitions (finished) are sent to the stockroom by the expediter. The assembly floor foreman draws the component items and completes the assembly for test and shipment.

5.33 Production Coordinator. The Production Coordinator is responsible for the actual scheduling of work. The expediters report to him and through them he may assign work to the operators.

The basic scheduling document is the Main Assembly Schedule which lists by weeks the major items to be assembled during the next few months. Essentially it is a listing of completion (assembly) dates for all major items whose orders have been accepted. This assembly date is usually set by the

plant manager after consultation with other members of management. Occasionally, this date is met only with great difficulty or missed completely.

Occasionally, management requests a weekly backlog of work per machine center. The production coordinator posts to this list all jobs for which he has received route cards indicating whether it is "firm" or "held up"; in addition, he includes his personal estimate on all probable forthcoming work.

Occasionally for large orders, the production coordinator prepares a shipping schedule which indicates estimated shipping (assembly completion) dates for all components.

The cost control auditor assisted by the production coordinator prepares a weekly report which compares actual labor charges with their estimated costs based on percentage of completion. This report is critically examined by management at a weekly meeting.

Day work items, ranging from long-term overhaul of entire sections of a paper machine to emergency repair of a specific item, constitute about 17% of Sandy Hill's business. These items are accepted by a large number of people who may promise unrealistic delivery dates and often do not consult the production coordinator at all. These items constitute a difficult scheduling problem and are highly disruptive to already scheduled work.

The production coordinator, keeping in mind the basic Main Assembly Schedule and the factors discussed in the preceding paragraphs, sorts the waiting route cards and lays out work through the expediters so that each machine or man is programmed 24 hours in advance. This is the heart of the scheduling function as it exists.

5.34 Scheduling and Planning. One function of planning is the process of analyzing capabilities and existing workloads to determine reasonably attainable completion dates for contemplated work. Scheduling is the allocation of production requirements to available facilities in the most econ-

omical sequence. Scheduling is the last step in production planning.

To accomplish this planning a central authority must have material availability information, backlogs for each machine center, the average daily capacity of each machine center, and the estimated hours required at each center for the item under consideration. This is an ideal arrangement and would yield accurate delivery dates if estimating standards are correct and unscheduled interruptions (day work) could be predicted. Various methods of planning, such as use of Gantt load charts, are available which will yield a reasonably attainable completion date for a given item to be furnished the scheduler.

Once the scheduler is given an attainable completion date, a material availability schedule, and a specified list of operations required (route cards), he may proceed to schedule the individual operation. He should schedule work to the machines as far in advance as practicable. He must consider each operation and assign those having common features in such a way that set-up, teardown time and lay out changes are minimized or at least done repetitively by the same operator. The scheduler must maintain accurate backlogs for each machine center. Day work or other interruptions must be handled through the scheduler who is best qualified to readjust and set the new optimum course of action.

The functions of planner and scheduler may be separate or combined. If they are separate, timely feedback information must flow. In either case the planner must be given information and authority to make delivery date decisions.

We recommend:

1. That a combined planning and scheduling function be established and well defined.

2. That the production coordinator (scheduler) establish or publish employment schedules as far in advance as possible (at least a week). See Chapter 6, "Industrial Engineering Handbook", ref. 51, for techniques. It is recog-

nized that interruptions will occur, but the basic assignment schedule should be an optimum one and in itself constitute the best basis for adjustments. There is no substitute for putting plans down in writing to force them into proper organization. Schedules are goals, and adjusting them to meet changing conditions does not decrease their value. Haphazard, inefficient assignments and delays result from hand to mouth scheduling.

3. That the production coordinator's duties be limited to scheduling, which is a full time job. He should be required to concentrate more on developing the most economic schedule and less on crisis scheduling to meet completion dates.

His assistants could probably be better utilized to complete some of the "staff work" incidental to scheduling. The practice of "special interests" exerting various pressures on the scheduler should be reduced or eliminated. The weekly progress report meeting should formally establish and change priorities when necessary.

5.35 Supervision. Controls are ineffective without supervision at the working level. It appears that the day shift foremen in the machine shop are largely ignored and their full potential is not being developed. Foremen should be assigned specific areas or men to be supervised and be given a measure of authority over them. The supervisor should receive a report from the methods section of his section's deviations from standard times on recent work, and he should be held accountable therefore.

Technical competence of foremen must be stressed as well as leadership. They must be trained in the proper use of equipment and best methods of layout, and they must also be able to teach others effectively. Promoting exclusively from within the organization often perpetuates weaknesses, unles selection is based on merit and ability as well as seniority.

The foreman's status should be raised and he should be a real representative of management. The shop superintendent should never have to check on an operator; the foreman should have done it already.

5.4 Methods and Standards.

5.41 Description of Existing Procedures. The Methods and Standards Department at Sandy Hill is composed of a Supervisor of Methods and three assistants. The department is essentially charged with the responsibility of determining the various operations necessary to manufacture the company's products, and the sequence in which these operations should be performed. The department also assigns standard times for each operation. These standard times are computed using standard data such as machine capacities, feeds and speeds, standard cutting and welding times, and estimated times for machine set-up and adjustment. An attempt is made to determine what, if any, special tools, jigs, fixtures or templates are to be required, and they are then designed and provided for. All of this information is entered on route cards, which follow the parts as they progress through the plant from raw stock to final completion. A file (called the control file) is maintained in the Methods Department containing cards upon which the details outlined above are noted for future reference. Cards are filed for all parts manufactured in the past, and are filed by drawing number. This historical file also notes the actual versus the standard times taken on each occasion when the part was made. There is a separate card for each drawing number. The actual times for the various operations are taken from time slips (made out by the individual workmen, themselves), which are sent to the Methods Department as the jobs progress. These time slips are accumulated for each part until it is completed, at which time the slips are totaled and the total actual time for each operation is entered on the appropriate card in the control file. Special reports are occasionally prepared for Management, from this data, indicating actual versus standard times for all operations on a given job, but only if the report is specifically requested.

There is no formalized, systematic procedure in use to keep shop supervisory personnel informed of the variances between actual and standard time.

The existing pattern of paper work flow through the Methods and Standards Department is represented in Figure 5-2.

5.42 Analysis of Effectiveness. Although the particular work tasks, their sequence, and the machine centers in which they are to be performed are specified by the Methods Department on the route cards, the particular methods to be used in performing the tasks are left up to the discretion of the individual operators. No program of work simplification or method standardization is in use, other than a general plant-wide suggestion program. Further, there is evidence that shop supervisory personnel, on occasion, do not follow the machine centers, or sequence, specified by Methods, in an effort to equalize the work load in the shop. There appears to be little time available for Methods Department personnel to study the various operations at first hand in the shop, with a view towards methods improvement. Much valuable time is spent studying new drawings and analyzing operations which are very similar to ones already analyzed in the past. Though the data relating to the previous operations is on file, it is frequently not used because of the difficulty in quickly locating the appropriate control card. (There are approximately 40,000 cards in the file.) Practically all items carry new drawing numbers which have no significance other than to serve as a numbering system. An efficient information retrieval system would greatly accelerate the location of data and the cross-correlation of data on similar parts, and save considerable time and effort which is now spent duplicating past data buried in the file.

Valid time standards should represent good, attainable performance. They should represent the time required for a normal operator to perform a standard work task, under normal conditions when working at a normal pace. Work methods have not been standardized at Sandy Hill, and therefore no really valid time standards can be set. In order to appraise the degree to which time standards, as prescribed by the Methods Department, are being met, a random sample of 1463 cards from the control file, representing past performance, were examined. Based on these samples, the average time actually taken expressed as a percentage of the standard time assigned was 197%. This figure indicates that, on the average, the operators are taking roughly twice as long to do a job as the Methods Department says they should. Furthermore, there was wide variance between actual times taken on the same operations, on the same machines, but done at different times. Some effort is made to revise the time standards

periodically in light of actual past performance, but these revisions are based on historical data only on non-standardized operations and include all past inefficiencies.

At Sandy Hill, it is questionable whether time standards actually serve any useful purpose, regardless of their validity. Basically, established methods and standards should serve as a basis for estimating time and cost of future work, as a means of keeping the workmen and supervisors appraised of what is expected of them in the way of good performance, and at the same time serve as a basic criterion for sound management control. Standards do not achieve control in themselves, but when properly used can be of great value in pointing out the necessity for timely corrective action when and where it is needed. Control is ultimately achieved at the first level of supervision (i.e., with the foremen on the floor), and unless management uses the standards to provide timely information on variances to the shop supervisors, they merely become past history. At Sandy Hill, no routine reports are made to supervisory personnel (or to anyone, for that matter), indicating variances from standard, and special reports are made to top management only on demand (which is usually too late to take corrective action).

At present, a considerable amount of "day work" (i.e., smaller jobs of relatively short duration) is undertaken at Sandy Hill. Some of this "day work" is accepted directly into the shop without being processed through the Methods and Standards Department in the normal manner. It is understandable that the emergency nature of some of this work requires that the jobs be expedited. However, it is questionable whether, under such a system, the work and time required (including set-up and tear-down time) is properly appraised when accepting such work. As a result, some of this work is accepted only on a "cost plus" basis. In addition, such "by-passing" tends to reduce the liaison and cooperation between the Methods Department and the shop.

Finally, at the risk of repetition in this report, it must be pointed out that in order for the Methods and Standards Department to make an effective contribution to Sandy Hill, a system for the proper utilization of the data it produces must be established. This will entail tightening the organizational structure, within the Manufacturing

division, and assigning responsibility to specific individuals for supervision in clearly defined areas, and affording them authority commensurate with the assigned responsibility. Only then can Methods and standards be used effectively.

We recommend that:

1. Management appoint a special committee within the company, or acquire the services of an engineering consultant, to select and adopt an efficient information retrieval system for quickly locating design information and control card data from the files. Consideration should be given to one of the commercially-available random coding systems.

2. Management undertake an immediate standardization program for hardware, materials, components, dimensions, and insofar as possible, entire paper and pulp machine sub-assemblies and assemblies.

3. Management institute a systematic report of actual work task times versus standard times at regular prescribed intervals to the Works Manager, Shop Supervisors, and especially to the foremen.

4. To enable recommendation number 3 to produce effective results, management establish clearly-defined areas of responsibility at the first level of supervision (i.e., foreman).

5. The liaison between the Methods and Standards Department and Machine Shop Supervisors be improved in order that Methods Department personnel may be encouraged to study operations on the floor to determine the best method for all basic operations, undertake work simplification projects where needed, and standardize these methods once they are approved by the Vice-President of Manufacturing.

5.5 Inspection Department.

5.51 Description of Existing Inspection Procedures. The

Inspection Department at Sandy Hill consists of a Chief Inspector and five inspectors. Normally, during the day, in addition to the Chief Inspector, three inspectors are available in the Machine Shop, and one is available in the Welding and Erection Shop. One inspector is normally on duty at night, when night work is scheduled.

Inspection department personnel are responsible for inspecting each element of all work passing through the machine shop, welding shop, and erection shop. It is standard procedure for each workman in the machine shop who has completed an operation to call an inspector to inspect the work before it is removed from the machine. The inspector then signifies his acceptance of that particular element of work by initialing that operation on the route card. All operations on the route card must be completely checked off, and the card must be signed and dated by the final inspector before the completed item will be accepted into storage. The Inspection Department personnel do not inspect work in the Pattern Shop or Foundry. Subcontract work and part of the purchased items are inspected upon delivery. The particular purchased items to be inspected are normally determined by the Receiving Department personnel, who direct incoming material to the Inspection Department for clearance before accepting it into stores.

The Inspection Department maintains testing and measuring instruments, some of which are issued to workmen on the floor. Inspectors also spot-check the accuracy of instruments in use on the floor, some of which are issued from the Tool Room.

A considerable portion of the inspectors' time is devoted not to inspecting, but to supervising on the Machine Shop floor.

Inspectors use tolerance limits as given on the engineering drawings as criteria for inspecting. When variations occur which are outside the stated tolerance, the matter may be referred back to the Engineering Department; or the inspector, himself, may decide whether or not to reject the item, based upon his general knowledge of the use to which the item will be put.

The disposition of material rejected is usually determined by the inspectors, themselves, unless the items in question are of considerable value, in which case the matter may be referred up the line for a decision. Rejection of work by the Inspection personnel is, on occasion, appealed by shop supervision when there is disagreement as to the usability of the item in question. This appeal (following the Company's open door policy) may go as high as the President.

5.52 Analysis of Effectiveness. The success of the efforts of the Inspection Department is evidenced in the high quality of the products produced by Sandy Hill. Actually, the inspectors do a great deal more than inspecting and testing, and in fact appear to spend a considerable amount of their time in direct supervision on the floor of the Machine Shop. It appears to this group that the Inspection Department is being used as a "crutch" by some of the workers, receiving guidance and assistance which should more properly come from the Shop Foremen. In such instances, the granting of this assistance puts the inspectors concerned in the unhappy position of inspecting work which they, themselves, have supervised.

Measuring and testing instruments at present may be in the custody of the workmen on the floor, may be issued by the tool room, or may be issued by the Inspection Department. There is at present no system of ensuring the accuracy of these instruments except for random spot checks by inspectors. Some degree of corroboration is obtained by using different instruments for inspection than were used by the workman.

Castings, delivered into the Machine Shop from the foundry (except for certain new castings), are not required to be inspected by Inspection Department personnel before macine work commences. It appears that this is a vital inspection point in order that those castings which can be determined bad by inspection will be rejected before valuable machine work is done.

Recommendations:

1. Consolidate all testing and measuring instruments under the cognizance of the Inspection Department. Establish a regular periodic checking procedure to insure the accuracy of all instruments.

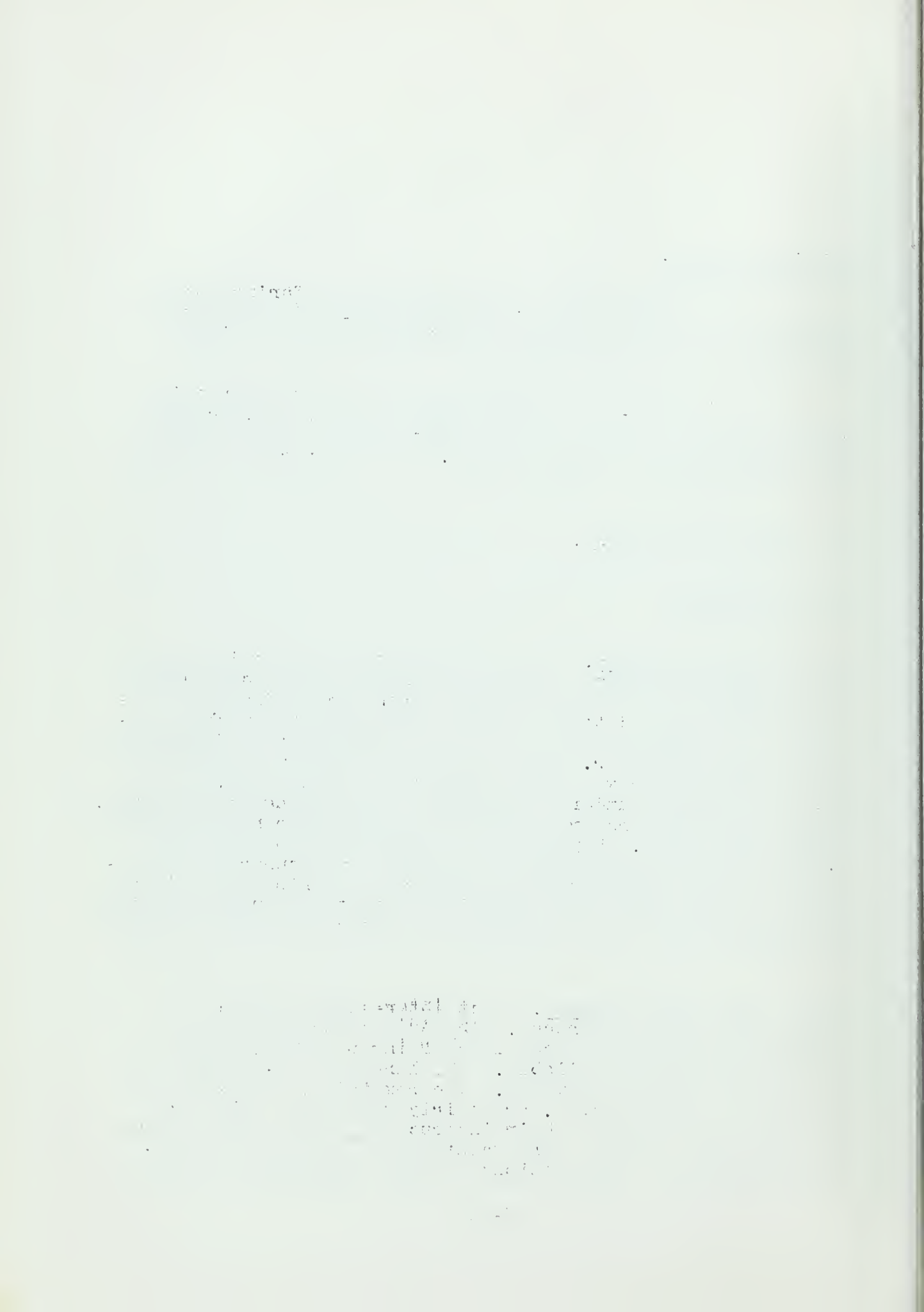
2. Subject each casting to a careful inspection prior to commencing any machine work thereon. Give careful consideration to sending all castings to the layout table upon delivery to the Machine Shop, to be inspected and signed off at this point.

5.6 Material Handling.

5.61 Equipment.

5.611 Overhead Cranes. Within the shops all material of any size is handled by the traveling overhead cranes described in paragraph 5.11. In the machine shop and welding shop requests are signaled to the crane operator by the machine operators or welders and the priority of movement is determined by the crane operator. The rigging is also done by the machine operators or welders, or, in the machine shop, by the move men (two men under a foreman). The rigging is impromptu. Though the operators wrap journals used as suspension points with rubber belts, they may use cleaning rags or whatever other material is handy as sling pads. The foundry crane operator receives his instructions from the senior supervisor when necessary, but is so experienced that he usually requires no instructions. Side bay cranes are operated by the machine operators.

5.612 Fork Lift Vehicles. Most inter-shop material is handled by fork lift trucks. In addition to a small one used exclusively on the cupola charging platform, there are five such vehicles available. The largest, a 7-1/2 ton 10-foot lift, is relatively new. The remainder, one 2-1/2 ton and three 2-ton vehicles, are fairly well worn. The fork-lift operators receive their instructions from a foreman who is responsible for all yard maintenance and inter-shop material handling. Instructions to this foreman may originate



in any shop and are ordinarily handled on a first come, first served system. The machine shop move foreman provides the yard foreman with a rough schedule of shop requirements a few minutes in advance of the desired movement. Material handling scheduling is otherwise non-existent. In event of overload of the material handling facilities, all shops compete for service, and priorities are determined by the yard foreman.

5.613 Trucks. When the material is not suitable for handling by forklift, one of five (four 5-ton, one 2-1/2 ton) leased International Harvester trucks may be used instead. These trucks are controlled in the same manner as the fork-lift trucks, under the same foreman.

5.614 Miscellaneous Equipment. The yard foreman also controls a portable yard crane used principally for lifting materials to the cupola charging platform. Also, he arranges for renting vehicles when the materials exceed the capacity of any of the vehicles on hand. For example, some extremely large drums for washing the raw paper stock have to be handled from the welding shop to the machine shop and are too big for the truck bodies. For these items a flatbed trailer truck must be rented (at about 50 dollars per trip) to carry the drums a scant 100 yards. For light materials, the move men in the machine shop use one of six hand trucks, two electric-powered.

5.62 Flow of Materials.

5.621 Incoming Shipments. All incoming materials except rail shipments are brought to a receiving dock in the north end of the store house (Storeroom #2) across the street from the main plant. The storekeeper makes up a Notice of Received Material, copies of which are provided to Purchasing, Inventory Control and to the Shop Production Coordinator, among others. Bar and sheet metal stock is stored in Storeroom #2. Most of the remaining material is transferred to Storeroom #1 after removal from the delivery vehicle. Rail shipments, such as lumber and foundry materials are delivered

directly from the siding to the storage yards and sheds.

5.622 Rough Castings. Castings, depending on their size, may be routed by one of several paths to the sanding room and machine shop. Very large castings are lowered between two small fork-lift trucks operating in tandem and removed from the rear (southwest) end of the foundry, and shifted to the 7-1/2 ton forklift for eventual transfer to the loading dock at the rear end of the machine shop. Other castings are taken by fork truck from the front of the foundry to the sanding room then across the yard through the side door of the machine shop. Small castings may be taken through the covered passage into the stockroom and later to the machine shop through the blacksmith shop.

5.623 Machine Materials. Materials undergoing machining may make several transits of the machine shop, following a variety of routes depending on the next operation. Such materials may go back and forth from the machine shop across the street to the welding shop several times before completion. One extreme example, an agitator fabricated of stainless steel, makes this trip nine times. Material for assembly may be sent to any of the three assembly locations described in paragraph 5.117, from there to go to any of the shipping points.

5.624 Finished Goods. Materials shipped by truck are usually transferred to the shipping section located in Storeroom #2, and are then loaded on the carrier either in the same dock used for receiving, or in the welding shop under the 30-ton crane. Rail shipments may be loaded either on the siding behind this building or on the spur at the rear of the machine shop.

5.63 Material Handling Complications. From the preceding description it can be seen that material handling at Sandy Hill is complicated by several factors:

1. A wide variety of materials of irregular shape.
2. A wide range of sizes.

3. A wide range of weights.
4. Irregular traffic patterns.
5. The necessity for removing material not being worked on from under valuable crane space.
6. The dispersion of the shops, particularly welding.
7. The policy of using machine operators, welders, molders, etc., for material handling.

In view of the foregoing it is essential that the intershop material handling equipment be roadable, versatile and capable of handling bulky, heavy loads. The combination of fork lift trucks and body trucks in use appears to be the most economical means of obtaining the required flexibility. The greater usage of forklift trucks appears to warrant increasing the ratio of forklifts to standard trucks. We recommend:

1. That within the shops, materials should not be handled by the operators but by specially trained men designated and paid as material handlers, for reasons of safety, efficiency, and economy.

2. That the scheduling of material handling should be integrated with the scheduling of work, with requests to the material handling foreman restricted to an exception basis, so that he follows the schedule, receiving requests only in event of unusual delays or early completion.

3. That the ratio of forklift trucks to standard trucks be increased, by leasing one less International Harvester truck and buying one additional M&M 7-1/2-ton forklift when funds are available.

4. That sling leathers and a supply of mover's padding materials be obtained and distributed to loading points to minimize damage by crane slings and set-downs.

5.7 Maintenance.

5.71 Maintenance Practices in General. The maintenance philosophy in effect is breakdown maintenance, supplemented by operator's routine maintenance. No maintenance records are kept. Maintenance costs are not recorded for each equipment. Breakdown maintenance is administered by the appropriate shop superintendent or foreman, who orders repair parts or initiates requests for manufacture of repair parts and overhaul as he determines necessary. Where inspections are made, no records are kept of the date, or maintenance needed or accomplished. A minimum of spare parts is kept on hand and no inventory records of these are kept. Reorders are made periodically upon exhausting the stock or upon visually noting depletion of stock in store. Considerable dependence on rapid delivery from local suppliers is the basis for low inventory levels.

5.72 Maintenance Organization. Three divisions of maintenance are in practice in the company. Operator maintenance of the mechanical equipment is deemed to be the responsibility of each operator, possibly supervised by the foreman or superintendent of the shop concerned. Electrical machinery maintenance, and maintenance of the service facilities including heat, steam, light, and water are the responsibility of the Welding Shop Superintendent, who has two full-time electricians and two plumber-steam fitters to assist him, This maintenance is also breakdown maintenance, supplemented by an attempt to inspect all controllers, motors, bearings, and wear parts at least once annually. One function of the electrical maintenance section is returning defective light bulbs to the guarantor. Yard and structure maintenance, and vehicle maintenance, are among the responsibilities of the Plant Engineering and Maintenance Superintendent. No records are kept by any of these divisions.

5.73 Effectiveness of Maintenance. There is no evidence to indicate that machine time lost because of use of breakdown maintenance in lieu of other maintenance programs is excessive. Without records such evidence is naturally hard to find, but the management states that no appreciable down-

time delays have ever occurred. In the conditions of low machine utilization observed, it is quite likely that the present program is as effective and economical as any. However, with a high workload it does not appear to be economical to completely ignore the costs of waiting for spare parts as is done here. We recommend:

1. The use of a maintenance history record for principal equipments, kept on a Kardex card. This card would provide a source of data for estimating what spare parts should be kept on hand and how frequently preventive maintenance inspections should be scheduled.

A further use of such a record is to determine, from rising maintenance costs, when an item of equipment should be replaced.

2. As a long-term project, the preparation of a maintenance manual to explicitly delineate responsibilities of the three existing maintenance divisions.

3. That maintenance planning be integrated with production planning for all items of equipment affecting production.

5.8 Layout.

5.81 Plant Layout. The plant layout of the Sandy Hill Iron and Brass Works is shown on Figure 5-1. This overall layout has evolved over a period of more than 50 years, and specific reasons for the arrangement have not been ascertained. There is no set pattern of work flow through the plant from "Receiving" to "Shipping", often visualized as the ideal, nor does the nature and variety of work lend itself to such a situation. The following information, however, is pertinent for appraisal purposes:

1. The building housing Receiving, Shipping, storage of metal stock and miscellaneous supplies, and the Welding and Erection shops is separated from the rest of the plant by a public street. Delivery, ship-

ment, or material handling to or from this building is by rail, truck, trailer, or smaller material handling devices.

2. When shipment is by rail, loading is performed at the western end of the machine shop where floor space is allocated for whatever assembly, crating and packing is required, and/or from the Receiving and Shipping Building.

3. In general the preponderance of work flow is as described in section 5.6 on Material Handling.

5.82 Layout of Welding and Erection Shops. This area is essentially floorspace, adequately served by an overhead crane and material handling devices. Items worked on are considered in fixed position and there are no significant findings with respect to layout.

5.83 Layout of Pattern Shop and Foundry. These two related activities exist for the primary purpose of producing raw castings. This appears to be a typical foundry operation and there are no significant findings regarding layout.

5.84 Layout of Machine Shop. The present layout of the machine shop is shown on Figure 5-3. Because of its size and extreme importance in the manufacture of company products, a good layout in this area can be a significant factor influencing shop productivity when properly coordinated with other factors such as good product design, planning and scheduling, methods and standards, material handling, inspection and proper supervision.

5.841 General Information. For purposes of appraisal, the first part of this study consisted of general discussion with personnel of the manufacturing activity in an attempt to ascertain reasons for the present layout, what plans exist for change, and what possibilities exist for further improvement.

Though in part repetitious of other sections of the report, the following information was developed which is considered pertinent to the subject of shop layout:

1. As in most machine shops, this shop has undergone minor and gradual changes such that there is no one layout which can be referred to conveniently as the "original" layout. Insofar as could be ascertained, most of the arrangement and addition of machines over past years was done on the basis of expediency, convenient availability of space, and suitable accommodation of the overhead crane for heavy lifting. Apparently little attention was given to work flow. The result can be described at best as a somewhat random functional grouping interspersed with unlike machines.

2. About 1956 a study of shop layout was initiated, and a layout plan exists which has not yet been fully implemented. This plan is essentially an attempt to achieve more nearly a functional grouping, though by no means completely so. The present layout then is considered a transitional one, and there is no definite time schedule for achieving further changes.

3. Supervision in the shop, below the level of the shop superintendent and his assistant, is performed by a Drill Foreman plus what might be described as three roving foremen who are not, on a regular basis, assigned responsibility for specific machines, areas, jobs, nor men. The plan for achieving a more functional arrangement of machines, mentioned in the preceding paragraph, was largely influenced by a desire to achieve better supervision by assignment of specific responsibility. At the same time better location, responsibility, and usage can be achieved for cutting tools, jigs, and fixtures which at present are moved about and borrowed with no formal control, so that a net loss in productive time results.

4. Though certain management policies are not in writing and difficult to establish as positive fact, in general it is felt that they have an indirect influence on the problem of achieving an optimum shop layout.

   (a) There is no enforced retirement because of age alone, and, except for cause in rare instances, men have not been laid off. It appears quite possible that the labor force has grown somewhat larger than has been required on an average over the years to accomplish the workload, if performed in accordance with efficient methods and standard times. This is an observation difficult to substantiate because of lack of written records and because, as brought out in other sections of this report, the Methods Department time standards are not really accepted nor adhered to on the shop floor. In fact, it appears that the very act of establishing scientific and realistic time standards is not subscribed to nor does it have a strong backing from top management. As a result the prescribed route card times are not always realistic and methods are not always followed where use of a different, less efficient machine will serve to keep a man busy.

   (b) The above situation is further confused by the fact that there is no one top level activity performing an overall production planning and control function nor is there a formal written schedule for daily shop work. Furthermore, the informal scheduling as practiced is subject to frequent change by the injection on short notice of new work, usually of a repair or rework nature.

5. Although some activity was observed of study of designs from a production standpoint in order to utilize the most efficient machines and methods and the best speeds and feeds, it ap-

pears that such activity is somewhat "piecemeal" rather than standard uniform practice.

6. In the forge shop it was observed that certain metal parts are heated cherry red and shaped or bent by hammer whereas modern practice would indicate the use of a press for example. Space in this area appears to be more than required for the activity observed.

5.842 Work Flow. In other sections of this report it has been stated that the manufacturing activity is essentially a highly variable job shop operation with respect to volume and composition of workload. This fact coupled with general information regarding lack of true standards, formal scheduling, etc., raises some question as to the significance of a study of present work flow of only a few items possible to include within the scope of this report. For brief study it was decided to trace the work flow on a typical dryer which is one of the heavier parts and over a year's span requires a significant number of shop hours. The work flow on this item is shown on Figure 5-4, following the sequence shown on a route card from the Methods department file and reproduced herein (Chart 5-4). In addition, an attempt was made to analyze work flow more thoroughly by sampling of a number of route cards and development of a cross chart. This was done in an effort to reveal or at least illustrate an approach in ascertaining the predominant work flow pattern as evolved by Sandy Hill in the manufacture of its products. Results are shown and discussed in paragraph 5.853.

5.85 Discussion of Layout.

5.851 Plant Layout. The most significant observation with respect to overall plant layout is that an excessive amount of material handling is required because of poor location of work areas with respect to each other. It is felt, however, that the limitations imposed by arrangement of present structures prevents making any but minor improvements in material handling methods. If new construction were to be considered, it is believed that an extension of the machine shop toward

SHOP OFFICES

INSPECTION ROOM

MOTOR DRIVEN OVERHEAD DOOR

GEAR LATHE #130

RADIAL SAW #12

GEAR CUTTER

GEAR HOBBER

LANDING

DN

FLOOR

ENGINE LATHE #

SINGLE WHEEL TOOL GRINDER

BIG SANDY #213

SHAFT BACK

SLAB MILL #19

ENGINE LATHE #24

ENGINE LATHE #143

ENGINE LATHE #

ENGINE LATHE # 21

420

172

ROLL GRINDING MACH. #5

ROLL GRINDING MACH. # 114

ENG. LATHE #159

ROLL ATTCH. DRIVE

14

113

830

530

ENG LATHE #172

SELLERS HORIZ BORING MILL #142

NO 2 PLANER

NO 173 PLANER

NO 4 PLANER

NO 3 PLANER

VERT BORE MILL #101

VERT BORE MILL #6

#126 TOOL GRINDER

DUAL WHEEL TOOL GRINDER

ARBOR PRESS

SHOP FLOOR

MANDREL PRESS #40

VERT MILL # 230

CABBAGE CUTTER #97

MILLING MACH. #8

RADIAL DRILL #194

DRILL PRESSES #18 #14

RADIAL DRILL

MULTI-DRILL #46

CENTER LESS GRINDER #132

TURRET LATHE #

#144 VERT

ENG. LATHE #

ENGINE LATHE # 208

FIGU

INSPECTION ROOM

TOOL ROOM

#180 TOOL GRINDER

#184 CARBOLOY GRINDER

#185 CARBOLOY GRINDER

#30 SURFACE GRINDER

#199 BRIDGEPORT GRINDER

#185 TOOL & CUTTER GRINDER

#100 CUTTER GRINDER

#188 CUTTER GRINDER

ROLL STORAGE

ENGINE LATHE #143

VERT. MILL #190

HORIZ. BORE MILL #19

36" VT LATHE

ROLL BALANCE MACH. #216

DRYER TEST AREA

ENGINE LATHE #21

VERT. BORE MILL #178

NEW BORING MILL #47

420

420

420

820

830

560
172

153
177
580

113

530

530

ROLL GRINDING MACH. #14

ROLL ATTCH. DRIVE

LAYOUT & INSPECTION TABLE

Pack & Ship

LOWER ELEVATION

RADIAL DRILL #194

RADIAL DRILL #193

RADIAL DRILL #112

KEYSLOTTER #10

SHELL DRILL #826

ROTOFORMER DRILL FIX.

MILLING MACH. #8

#13 DRILL PRESSES #14

LAY-OUT TABLE

TABLE DRILL PRESSES #208

ENGINE LATHE #209

TURRET LATHE #1

ENGINE LATHE #208

BENCH GRINDER #131

DUAL TAPPER TOOL GRINDER #126

#132 BENCH DRILL

FIGURES 5-3 AND 5-4 LAYOUT, MACHINE [illegible] AND DRYER ASS'Y FLOW DIAGRAM

DATA FROM ROUTE CARD: DRYER ASSEMBLY

	Item	Code	Operation	Machine	Std. Hrs.
Head	HT-1	820	Turn and Face Complete leaving stock for turning and Grinding taper in Eng. Lathe.	V.B. Mill	6.00
	HT-3	530	Drill-use template T3/2503 Drill&Tap End from Lock Plate Drill&Tap for 3/8 NPT & 5/32 Conn. Hole	Large R.Drill	2.6
	HT-4	112	Grind & Mark ser. no.	Hand Oper'tn	.50
	HT-5	830	Face for cover	H.B. Mill	.50
	HT-6	420	Taper & Grind Journal	E. Lathe	2.00
					11.60
Head	HD-1	820	Turn & Face Complete	VB Mill	8.75
	HD-2	830	Mill Kwy	HB Mill	.75
	HD-3	530	Drill Drill and Tap End Drill Conn. Hole	L.R. Drill	4.20
	HD-4	112	Grind&Mark ser. no.		.50
	HD-6	420	Thread,taper & grind	E. Lathe	3.00
					17.20
Shell	S-1	172A	Put Spider in	Floor Assy.	2.50
	S-2	420	Cut&Remove Riser	E. Lathe	1.00
	S-3	420B	Rough Cut 1 Chip	E. Lathe	9.00
	S-4	420C	Face & Bore Ends	E. Lathe	9.00
	S-5	172B	Floor Disassemble Spider		1.00
	S-6	420D	Set up & Bore	E. Lathe	12.64
	S-7	560	Drill & Tap	Aut.Horiz.Dr.	5.0
					40.14
Assy.	D-1	172	Assemble	Floor	3.00
	D-2	420A	3 Cuts on OD.	E. Lathe	14.24
	D-3	420B	Mach. Rope Groove		2.75
	D-4	153	Balance	on Floor on Heavy Duty Horses	3.00
	D-5	177	Test Hydrostatic		4.00
	D-6	580	Drill&Tap name Plate	Floor	.50
	D-7	113	Roll Grind D finish D Total	Roll Grinder	14.0
					41.49
				Total	110.43

CHART 5-4

the river and relocation of the Welding and Erection shops therein would effect a definite improvement in supervision, work flow, and efficiency of material handling.

5.852 Machine Shop. On a long-range basis it is believed that the present layout can be greatly improved. However, it does not appear wise nor feasible at this time to make substantial changes in the present layout aside from the existing plan to achieve a more substantially functional layout permitting more specific assignments of supervisory responsibility. This in itself should result in a definite improvement in efficiency of performance. It is realized that some of the information presented in paragraph 5.841 is repetitious of findings in other sections of this report. It was repeated intentionally, however, in order to emphasize what appear to be shortcomings in present policies and procedures. In order to analyze and make improvements in shop layout on a sound basis certain prerequisites are mandatory. A program of simplification and standardization should exist. Sound design for production through effective liaison between manufacturing and engineering should be standard practice. The establishment and adherence to methods and standard times must be practiced with the strong backing of top management. Some type of formal scheduling of shop work should exist even though deviations are necessary. On this sort of firm foundation the number of machines required of various types can be determined within the scope of present and projected future business. An analysis of work flow can be made on the higher volume items, particularly those wherein material handling requires relatively significant time and manpower. Then the task of improving shop layout can be undertaken with reasonable assurance that full advantage will be taken of all factors influencing that layout.

5.853 Investigation of Work Flow. An examination of the present shop layout indicates that where several machinery operations are required on any given part, the dispersal of various types of machines must of necessity require handling of material over considerable distances, particularly where assembly, layout, floor operations, or storages are also involved. In consideration of the high overall costs of material handling in general one important justification for

CHART 5-5

From \ To	Drills	Grinders	Roll Grinders	Eng.Lathe	V.B.Mill	H.B.Mill	Milling	Gear Cutters	Planers	Shapers	Assembly	Bench	Layout	Out of Shop	Total
Shop Entry	164	13		146	350	69	52		26		145		145		1060
Drills	1	466	4	112	10	52	11			2	110			138	911
Grinders					5	2					2			562	571
Roll Grinders					2									138	140
Eng.Lathe	206	10				2	12			10	194		14	24	472
V.B.Mill	235	10				138				2			29	18	432
H.B.Mill	178	23		103						2			55	2	363
Milling	4	11	9	7							2		27	9	69
Gear Cutters						4							4		26
Planers	18												4	2	16
Shapers		10													
Assembly on Floor	12		132	310		103	8							85	650
Bench Layout	226				2										228
Total	1044	543	145	676	369	370	83	--	26	16	453	--	278	978	

CROSS CHART, SHOP WORK FLOW

layout study is the possibility of reducing material handling operations by proper arrangement of equipment. The Flow Diagram of a Dryer shown in Figure 5-4 is one example wherein very heavy parts are transported by overhead crane over a substantial portion of the shop several times to complete the sequence of operations for one assembly. This study is not intended to be conclusive but strongly suggests a need for improvement. The best arrangement, however, can only be determined by a thorough study of many parts, particularly those which are made in large numbers, relatively speaking.

One approach to such a study, recommended especially in plants having a variety of non-standardized parts, is the development of a cross chart. The main purpose is to determine the amount of movement between each combination of two operations or areas. This can be done by referring to route cards. Each move is recorded opposite the appropriate "from" and "to" columns and the moves from each operation to each other operation are then tallied and totaled. In order to illustrate this method, a cross chart is shown in Chart 5-5. This chart was developed by sampling Sandy Hill route cards and represents the flow of numerous parts or assemblies including dryers, pumps, gear reduction drives, rolls and others. In each case consideration was given to the number of parts or assemblies made in recording the individual moves. A complete study of this type, applicable to the Sandy Hill shop, might also be weighted by such factors as the relative difficulty of moving various parts. In deciding on the desired shop layout, consideration would also be given to the location of certain machines which must be served by the overhead travelling bridge crane or by smaller capacity hoists, and to location with respect to access doors. Again, for illustrative purposes only, an analysis of the cross chart to the extent developed by sampling indicates definite evidence of a large flow TO drills, and FROM drills TO grinders TO out-of-shop. Also there seems to be a significant flow, in various combinations between the functions of assembly or layout, lathes, boring mills, and drills indicating the need for appropriate relationship of location of these areas. It is felt that a complete development of this approach would have to include results from a much larger sample and would be worthwhile only if the aforementioned prerequisite conditions are implemented.

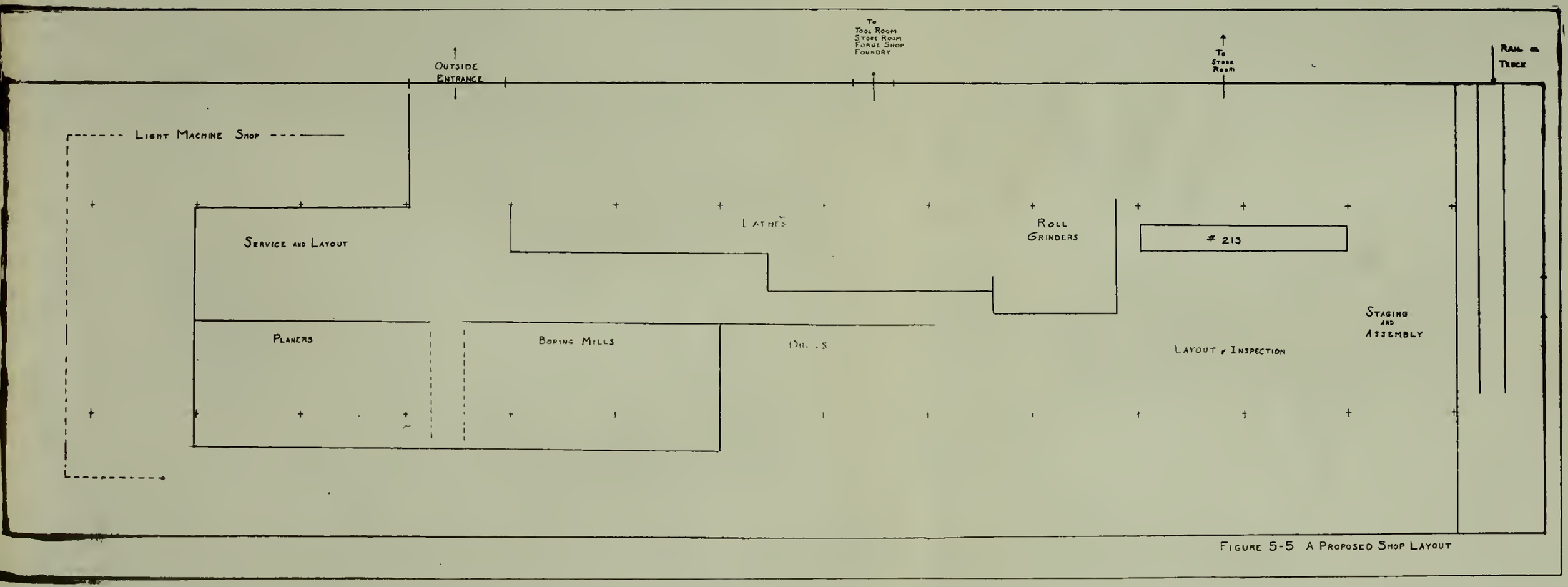


Figure 5-5 A Proposed Shop Layout

With respect to work flow and shop layout one additional factor was noted which should be given some consideration. There seems to be a distinction between those parts processed by what may be termed a "heavy" machine shop and those processed on the smaller machines which may be termed a "light" machine shop. It is suggested that overall work flow could be improved then, not only by functional grouping of machines but also be division of the shop into "light" and "heavy" shop areas. Though lacking in detail which would require much more study and analysis, as a long-range objective one possible arrangement is shown in Figure 5-5 dividing the shop into "light" and "heavy" shop areas, which, it is felt, would facilitate flow of work and reduce material handling. In addition, it is submitted that manufacturing methods and operator skills differ between light machine work with generally closer tolerances and use of higher speeds, and heavy machine work. Thus better advantage could be taken of specialized operator skills in those areas, better supervision could be effected simultaneously, and with adequate operator versatility, efficient utilization could be achieved of an optimum number of workers for the average workload.

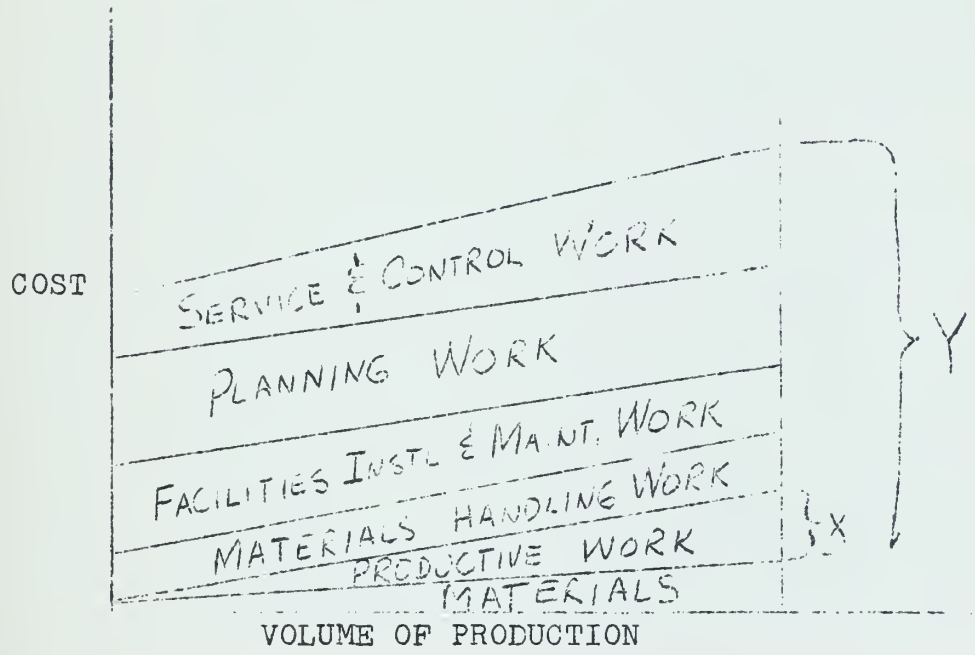
For general reasons stated in the appraisal it is recommended that for the present an attempt be made, with a minimum of rearrangement, to achieve sufficient functional grouping of machines to permit assignment of definite supervisory responsibility by machine areas and men. On a longer-range basis it is recommended that the mentioned prerequisite conditions be effected which will permit a realistic analysis of shop layout followed by whatever rearrangement is then indicated with particular attention being given to division into light and heavy machine shop areas and true functional grouping which will best accommodate the majority of work flow and be most adaptable to specific supervisory assignments.

5.9 Utilization of Manpower and Equipment.

5.91 Productivity. In analyzing any organization it is useful to compare the results achieved with the effort expended. The organization's effectiveness may be partially indicated by measuring what part of the total effort contributes directly to the results. In a manufacturing activity this is

closely related to the concept of productivity.

Productivity may be defined as the ratio of productive work achieved to the total of all direct and indirect work required in its accomplishment. Productive work shapes, assembles, or alters usefully the materials which make up the product. All other effort contributes nothing directly to the final product and may be looked upon as overhead to productive work. Graphically it would look like this:



$\frac{X}{Y}$ = Productivity

Obviously, our aim is to minimize Y and to make the ratio of X to Y as large as possible.

Some of the factors which influence productivity are as follows:

1. Organization objectives must be defined as the first step in maximizing productivity. Normally a corporation is in business to sell a product or service at a profit. The range of products and services must be carefully defined because no company can be all things to all customers. In this age of increasing specialization most successful manufacturers pick out a section of the market and concentrate their efforts on producing a better product at a lower cost. Market research is treated elsewhere, but it is essential that objectives and courses of action for the company be clearly defined. Everyone in the company should be well aware of these and just what their individual contribution can mean thereto.

2. Product design determines the complexity of the task of the entire organization. If engineering has made the product as functional and easy to manufacture as possible, productivity is automatically increased. The paramount importance of design has been discussed in Chapter IV, Engineering, but it may be added that simplicity and standardization pay an additional bonus by building up production skills through repetition of the same operation. It has been said that the seeds of an organization's financial success are sown in its design concepts, philosophies and practices. Probably no other area offers such financial rewards for the corrective effort expended.

3. The staff contribution should be considered. Accounting, purchasing, methods, cost control, order department, supervision, scheduling, tool rooms, pattern shop, inspection, maintenance, shipping, stock rooms and many others contribute nothing directly to the product. They do not change the product's usefulness, shape, or value. They exist solely to facilitate the productive effort which does alter the material constituting the product. Their justification may be measured by how well they support the money making production operations.

4. The production operator may appear from the foregoing to be the only useful person in the company. It is true that the man on the machine is the only one who has an opportunity to create product, but his total effort must be analyzed also. How much of his time is spent obtaining tools, interpreting drawings, setting up, handling materials, watching the machine run, or in other activity which contributes nothing to the product? How much useful product has he turned out for eight hours work? Compare the productivity of the man on the old machine with the productivity of the man on the new machine. Mechanization changed our civilization largely through its ability to increase the productivity of human effort. No organization can survive unless its management utilizes every technique available to boost productivity.

Management should create an awareness of productivity at all levels. Work simplification and motion economy should be fostered. Foremen must be trained to teach and insure that every move of the operator counts. All possible benefits of proper scheduling should be sought.

Where management policy is to endeavor to keep workers on the rolls at full pay regardless of reduced business level, the necessity for maximum productivity is apparent to management but not to the worker, who tends to slow down under a light load. Management must insist at all times that operators strive for the same high level of productivity, or the sub-standard performance will come to be accepted as the standard.

The possibility of a gradual reduction of the working force accompanied by assignment of more than one machine to a man (to reduce time wasted in watching long machine cycles), and the acquisition of new machines with higher capacities should be considered. We believe this step could be accomplished as a long-range project without affecting the "family" personnel policy of the company.

5.92 Utilization. The utilization of manpower and equipment may be determined by measuring how an organization employs its men and machines. We can compare the time spent in different categories of employment with the total time available. No attempt has been made to appraise the efficiency of the work observed; it has only been broken into differing categories.

The technique employed to measure utilization is work sampling. It consists of the random sampling or observing of the activities of men and machines. From a relatively small number of random observations, we can state within specified limits of accuracy the utilization we might expect to find if we recorded continuously the activities of men and machines.

Work sampling is one of the most versatile and powerful tools of management. It is an inexpensive and accurate method of determining facts. A discussion of the process and its applications is found in Chapter 5, Section 3 of the "Industrial Engineering Handbook," by H. B. Maynard (McGraw-Hill 1956). (Ref. 51)

5.921 Work Sampling. Observations were made at random times on Tuesdays in February, March and early April and are felt to be representative of average shop operations. Random routes through the machine shop were taken by observers who noted the instantaneous activity of men and machines as they came abreast of them. The activity was noted and a check mark placed in the appropriate box of the observation form. A machine was recorded as producing if it were actually shaping metal. A man was recorded as producing if he was using a hand tool or otherwise directly shaping the product. A summary of the 2643 observations is as follows: (See Chart 5-6.)

The total machine utilization observed was 33.3%. The number of observations was 1287 and the standard deviation was 1.31%. The 95% confidence limits of the utilization were $33.3\% \pm (1.96)(1.31\%)$ or 30.7% to 35.9%. This means that on any day chosen at random, 95 times out of 100, the observed machine utilization will lie between 30.7% and 35.9%.

SUMMARY OF WORK SAMPLING DATA

MACHINES

Activity	L. Eng. Lathes	S. Eng. Lathes	Turret Lathes	V.B. Mills	H.B. Mills	Millers	Drills	Planers	Misc.	Roll Grndr.	Total	Per Cent
Producing, Attended	42	80	37	43	19	15	31	22	28	48	365	28.4
Producing, Unattended	8	9	5	9	0	2	5	7	6	12	63	4.9
Total Producing	50	89	42	52	19	17	36	29	34	60	428	33.3
Maintenance	6	13	3	0	0	3	1	3	6	0	35	2.7
Set-Up, Tear Down	28	40	12	34	17	23	23	19	6	4	206	16.0
Adjust	1	19	11	8	3	2	3	6	1	2	56	4.3
No Assignment	18	66	41	42	17	55	119	74	122	8	562	43.7
Total	103	227	109	136	56	100	182	131	169	74	1,287	100.0
Percent Utilization	49	39	38	38	34	17	20	22	20	81	33	

CHART 5-6

MANPOWER

Activity	Total	Percent
Producing	185	15.7
Watching Machine Cycle	220	18.7
Maintenance	81	6.9
Set-Up, Tear Down	165	14.0
Adjust	110	9.4
Handling Material	155	13.2
Clean Up	75	6.4
Personal or Inactive	185	15.7
Total	1,176	100.0

Machinery depreciation and maintenance expenses are estimated to total $110,000 annually. To emphasize the cost of non-productive activity, these costs may be apportioned on the basis of the utilization of the machines as follows:

Activity Type	Observed Percent	Annual Cost
Producing	33.3	$ 36,600
Set up, Tear down, Adjust	20.3	22,300
Maintenance	2.7	3,000
No Assignment	43.7	48,100
TOTAL	100.0	$110,000

CHART 5-7

The manpower utilization figures are considered to be conservative since they do not include observations of workers who may be off the production floor, and no observations were made during coffee breaks.

Assuming the total cost of shop labor to be $1,250,000 annually and extrapolating observed machine shop utilization to include all shop areas, we may apportion shop labor costs as follows:

Activity Type	Observed Percent	Cost
Producing	15.7	$196,000
Watching machine cycle	18.7	235,000
Set up, Tear down, Adjust	23.4	292,000
Handling material	13.2	165,000
Maintenance	6.0	86,000
Clean up	6.4	80,000
Personal and Inactive	15.7	196,000
TOTAL	100.0	$1,250,000

CHART 5-8

The results displayed in the foregoing charts, though based on a limited amount of data are an indication that productivity in the machine shop is subject to improvement. For example, the fact that the average operator spends about one fifth of his time watching the machine cycle indicates the possibility that one man may satisfactorily tend more than one machine.

The manner in which the survey was conducted gave a lower figure for time spent in material handling than probably exists, as observations were confined to men within the area of the machine shop.

As we have noted, the work sampling done in this study is not conclusive because of the limited time devoted to the project. An exhaustive sampling program, correlating observations with actual production during the period, can yield a valuable measure of activity in the categories under study.

5.10 Summary of Recommendations. We recommend:

1. Separate the Manufacturing and Sales Departments.

2. Establish a Planning Section reporting to the Vice President of Manufacturing, having the functions:

a. Production planning and estimating.
b. Production scheduling of all work, including day work.
c. Inventory control of maximum/minimum levels and issue priorities.
d. Traffic control.
e. Maintenance planning.

3. Strengthen the functions of Methods and Inspection by assigning them as staff assistants to the Vice President.

4. Give the Works Manager full line authority over all the producing shops and personnel, including the foundry, and in addition, plant maintenance.

5. Strengthen the supervision in the shops by

a. Delineate in writing the specific areas of responsibility of all levels of supervision.
b. Increase competence of the foremen by training and selection.
c. Inaugurate a system of merit rating to govern promotion, pay increases, and bonuses.

6. Encourage and provide backing for the establishment of and adherence to realistic methods and standards.

7. Undertake an immediate standardization program, and adopt an efficient information retrieval system as recommended in Chapter IV.

8. When significant results from steps 6 and 7 have been achieved, make a study of the machine shop layout, considering the possibility of achieving true functional arrangement and division of the shop into light machine and heavy machine shop areas, with the objectives of reducing material handling, improving supervision, and increasing utilization of personnel.

CHAPTER VI - MARKETING AND SALES

6.1 Marketing.

6.11 General. Industrial marketing at Sandy Hill is maintaining adequate contact and communication with customers and prospective customers with the intention of selling pulp and paper making machinery. In this regard the plant's primary goal is to use the right promotional effort to have customers desire the equipment and to use incentives which will inspire selling efforts by sales personnel.

In the selling of equipment in the pulp and paper making field, the effectiveness of personal contact of top-management, middle management and sales personnel plays a major role in acquiring initial and repeat orders.

An equally important phase of marketing is the delivery of equipment on the promised date. Very frequently, Sandy Hill's delivery date of a piece of equipment depends upon the personal attention, interest and position of the person who made the initial contact or sale. The effect of such a procedure has made it practically impossible to have an orderly and predictable delivery schedule.

6.12 Organization. Marketing is a line function which comes under the Vice-President, Sales and Manufacturing, who reports directly to the President. The organization of the department is principally a functional structure with personnel, advertising, sales planning and "manufacturing" elements coming under this Vice-President. Sales and Manufacturing are combined because the present Vice-President has had a lengthy and varied association with the company.

In the sales department there are basically two (2) groups. The home office group is composed of the Vice-President, an assistant Vice-President, a sales estimator (who processes orders and makes estimates on routine jobs), and a pooled clerical force. The second group is composed of eleven salesmen, each of whom covers an assigned area. Areas presently

covered are: #1, Hudson-Mohawk Vallies of New York and immediately adjacent territory; #2, Connecticut, Massachusetts, Rhode Island; #3, Illinois, Kansas, Missouri, Indiana, Michigan, Ohio, Iowa, Minnesota and Wisconsin; #4, (Kamyr line only) California, Idaho, Washington and Oregon; #5, Arkansas, Oklahoma, Louisiana, Texas, Mississippi, Mexico; #6, Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia, North Carolina; #12, Maine, New Hampshire, Vermont and Western New York; #13, Alabama, Florida, Georgia, Mississippi (Moss Pt. only), Tennessee, South Carolina and part of North Carolina; #15, same as #4 except for all equipment excluding Kamyr.

At the present time there is no formally assigned person or group for Market Research or Sales Forecasting. Research and forecasting information is based on the collective information, experience and opinion of management personnel.

Advertising is under an assistant Vice President, who writes and edits "sales-engineering" technical information for the sales catalog and trade journals. Additional publicity, advertising and assistance in writing pamphlets is handled by the assistant to the above assistant Vice-President.

The operation of the Manufacturing function is covered in Chapter V.

6.13 Nature of the Market - General. The demand for the products of Sandy Hill is a derived demand. The needs which the customers have for pulp and paper products is determined by the requirement which is placed upon the pulp and paper manufacturers for their products. The growth of paper and paperboard manufacturing in the United States together with an estimated projection of this continued growth through 1965 is shown in Figure 6-1. Data used in Figure 6-1 is based upon information in House Report No. 573 of 85th Congress.

The current sales potential for pulp and paper machinery is thus determined by the present and projected demand for paper and paperboard products. Regardless of

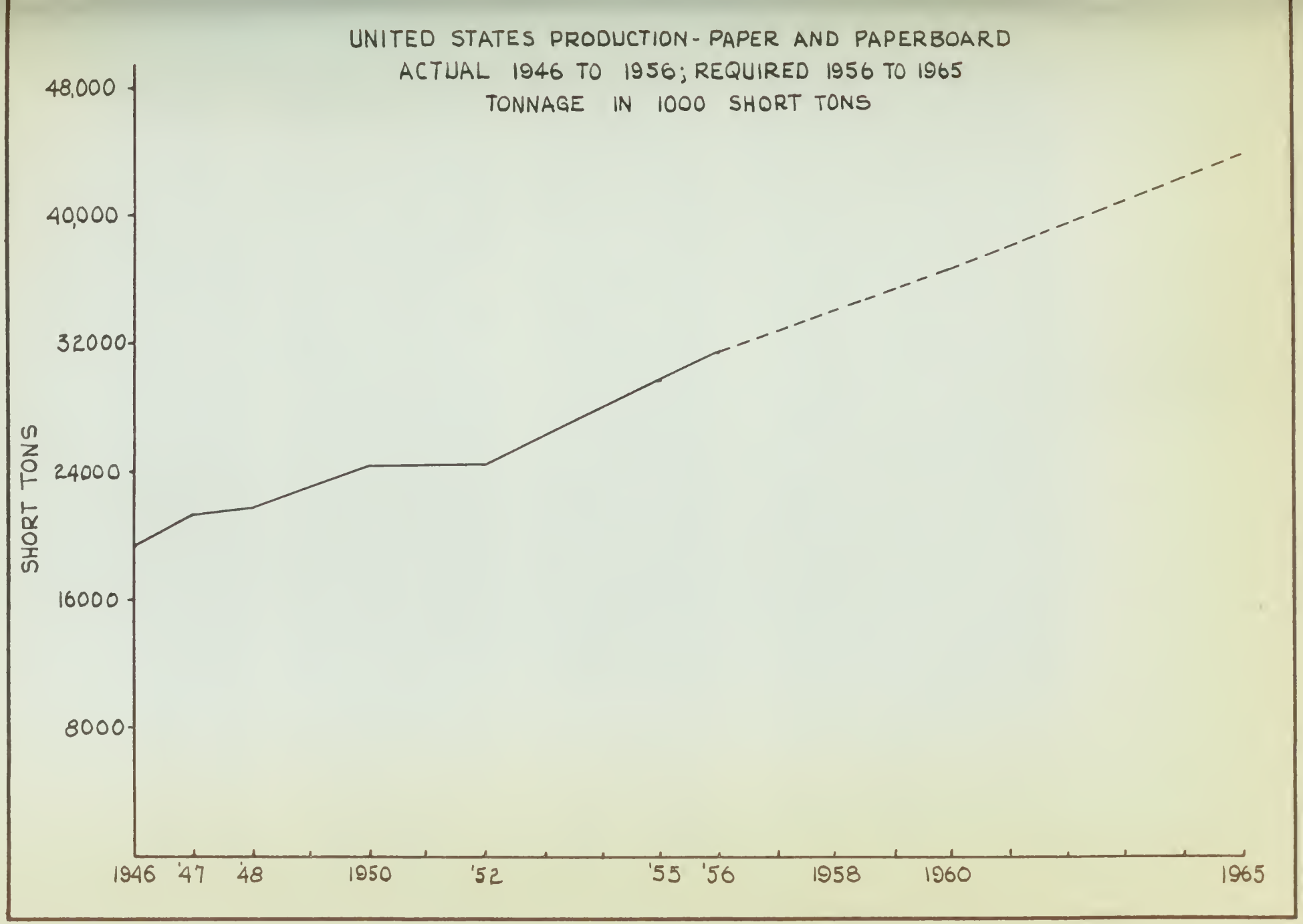

UNITED STATES PRODUCTION - PAPER AND PAPERBOARD
ACTUAL 1946 TO 1956; REQUIRED 1956 TO 1965
TONNAGE IN 1000 SHORT TONS
48,000
40,000
32000
24000
16000
8000
SHORT TONS
1946
'47
'48
1950
'52
'55
'56
1958
1960
1965

FIGURE 6-1

how competent the sales force of Sandy Hill may be, they will be relatively ineffective in selling their products in a static market or a market in which the customers have over-expanded. The market for paper and pulp machinery is vertical not only because the customers are specialized but also because they are limited in number. From an analysis of Sales for the period 1946 - 1957, approximately seventy percent (70%) of the business of Sandy Hill was conducted within the United States. The remaining thirty percent (30%) was the result of markets outside the United States. According to Sandy Hill sales personnel, approximately eighty percent (80%) of all orders are handled on a custom-made basis. The remaining twenty percent (20%) consists of orders which are produced on a job shop basis and are considered to be standard parts.

On several occasions Sandy Hill has been entrusted with confidential technical information from various customers. This procedure has been followed in order to permit Sandy Hill to provide certain special types of equipment and technical services. All such arrangements have resulted in customer confidence in the company because this entrusted information has always been closely held. This mutual confidence has been the basis for subsequent sales and engineering services for Sandy Hill.

6.14 Customers. The customers are the primary concern of Sandy Hill. Their satisfaction is the primary basis upon which the company conducts its business in the field of paper and pulp mill machinery manufacturing. The customers, together with their orders vary considerably. The dollar value of orders range from a specialized order for a given part for as little as one dollar to an order for a complete paper and pulp machine which sells for several million dollars. In addition, the company does sub-contracting work for customers other than the paper and pulp industry.

According to Post's Paper Mill Directory, there are at present approximately one thousand one hundred (1100) paper, board and pulp mills in the United States. This is a relatively small number when compared to the great number of customers which are available to purchase consumer paper products. There has been a substantial growth in the paper and pulp in-

dustry in the United States in recent years (Figure 6-1). However, this growth in paper and pulp production has been paralleled by a similar growth in both the number of paper and pulp machinery manufacturers and their combined volume of sales. Information contained in the 1954 Census of Manufacturers, Volume II, Industry Statistics substantiates the growth both in number of manufacturers and value of shipments. This total increase in value of shipments related to Sandy Hill sales increase for the period 1937-1954 is shown on Figure 6-2. An analysis of statistics used in Figure 6-2 indicates that the 1954 industry-wide value of shipments increased four hundred fifty-five percent (455%) over 1937 value, whereas Sandy-Hill value of shipments increased eight hundred twenty percent (820%) during this same period.

Sandy Hill can handle orders for complete paper and pulp machines or any component thereof. However, they are limited insofar as complete machines are concerned to those which handle up to one hundred eighty-four inches (184") in width. Although all paper making machinery is basically the same, the greater the width of the machine the harder it is to control the quality of the paper. As a result, the various types and qualities of paper products require various types and sizes of machines. Some specialized paper products require little machines and some products require big machines. Hence the present state of the art indicates a market for both small and large machines in the foreseeable future.

The nature of the paper and pulp machinery according to Sandy Hill, is such that most of it is custom made and has a long, useful life. Thus the turnover or resale rate is very low. There are a few Sandy Hill paper machines that have been in operation for more than 50 years. This durability of the products together with the custom nature of each plant tends to keep the customer returning to the original source of purchase for any replacement parts.

In recent years there have been many paper machines made which are considerably larger than the maximum width of 184 inches which can be made by Sandy Hill.

The customers within the United States who desire continuous pulp bleaching equipment can purchase this ma-

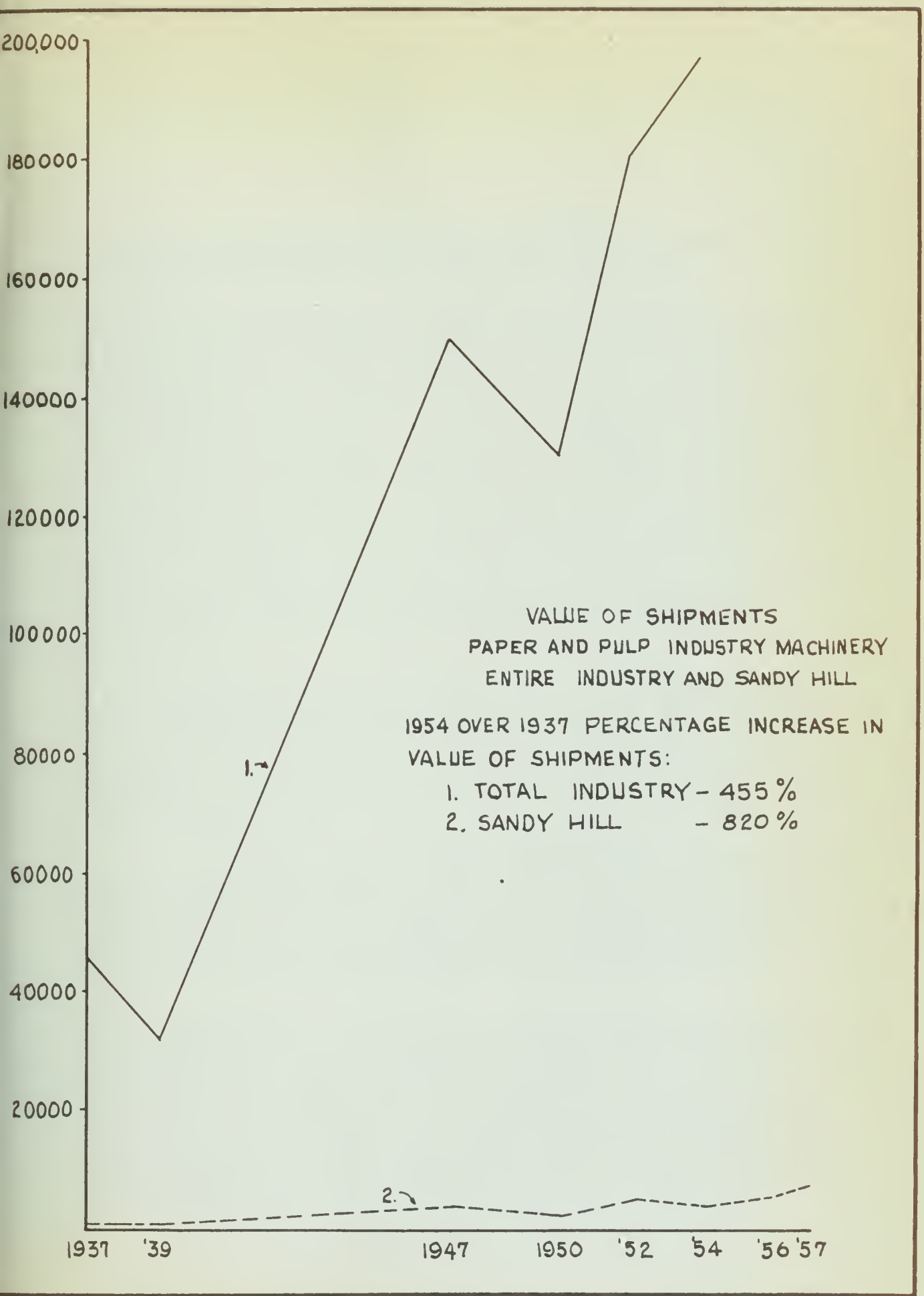

200,000
180000
160000
140000
120000
100000
80000
60000
40000
20000
1.
2.
1937
'39
1947
1950
'52
'54
'56
'57
VALUE OF SHIPMENTS
PAPER AND PULP INDUSTRY MACHINERY
ENTIRE INDUSTRY AND SANDY HILL
1954 OVER 1937 PERCENTAGE INCREASE IN VALUE OF SHIPMENTS:
1. TOTAL INDUSTRY - 455%
2. SANDY HILL - 820%

FIGURE 6-2

chinery through Sandy Hill. This equipment is known as Kamyr (See paragraph 6.4).

6.15 Customer Relations. Sandy Hill's customer relations are maintained primarily by direct contact through eleven salesmen. Nine of these salesmen are engineers who are familiar with their products and can provide technical customer service and advice. In addition, engineers and qualified management personnel in the home office are available for exploratory studies, suggestions or likely solutions to the customers' problems, and to provide technical assistance for the design, manufacture, and installation of proposed equipment. In addition, the Vice-President, Sales, makes semi-annual field trips and visits with the customers in each area together with the salesman assigned to that area. Besides those mentioned above there are many individuals of the company, including top management, who maintain an active part in the sales and customer relations program.

6.16 Manufacturing/Sales Agents. All the products of Sandy Hill which are sold within the United States are sold direct to the customers. There is one manufacturer's agent on the West Coast who represents Sandy Hill in the sale of Kamyr equipment. In the domestic market the eleven company salesmen are each assigned to a geographical area and he is the only salesman for the company in that particular territory.

On the foreign market, export-import agents have been utilized from time to time. It is the present policy of Sandy Hill to sell to anyone in the foreign market who may desire to place an order with the company for the type of equipment they make. There are no exclusive foreign agents who represent Sandy Hill at the present time.

6.17 Competition. Currently available data (1954 Census of Manufacturers) indicates there are one hundred sixty-nine establishments in the United States which are engaged in the manufacture of paper industries machinery. Of this group one hundred fourteen (114) establishments have 90% or more specialization in paper industries machinery, fourteen (14) have 75-89% specialization, twenty-four (24) have 50-74% specialization and the remaining seventeen (17) do less than 50% of their total work in paper industries machinery.

Many well equipped foundry-machine shops and job shops which have the engineering talent, specifications and drawings could be considered competitors for some paper industries machinery.

However, there are six companies which manufacture entire machines. Five of these are the manufacturers Sandy Hill considers to be major competitors. Within this small number, Beloit, Rice-Barton, Pusey & Jones, Valley Iron Works and Black-Clawson have the talent and equipment to make entire paper machines and replacement parts. Presently installed equipment in the Sandy Hill foundry and machine shop limits the size of some equipment which Sandy Hill can manufacture. This is not the case in all instances with their competitors.

Within the past ten years Sandy Hill has been successful in selling pulp paper machinery in a few foreign countries. Although these foreign contracts contributed greatly to the success of the company, American builders cannot compete on a price basis with Japan, Switzerland, England, Germany, Italy or other foreign countries. The successful business transactions in foreign countries have been those which were negotiated through the Export-Import bank or instances where foreign installations were made with American capital.

6.18 Kamyr. "Kamyr" is the engineering and research organization of three leading Scandinavian pulp and paper mill machinery manufacturers. In the development of pulp forming equipment KAMYR produced the world's first feltless wet machine in 1918. The KAMYR method of pulp forming results in tremendous savings in felts, wire, maintenance and labor which also means savings in utilities. The conventional making-roll wet machine has important uses where pulp is to be accumulated in relatively small quantities for storage in a mill or for short-haul shipment and in those instances where the daily quantities involved would not justify economically the use of the high capacity KAMYR wet machine.

Sandy Hill first formed an alliance with KAMYR in 1934, the same year Kamyr invented the UPFLOW TOWER for the chlorination stage in the cycle of pulp bleaching equipment. In 1946, through a broadened contract with Kamyr, the firm

hired an engineering technician who became manager of the pulp division. The sale of Kamyr equipment by Sandy Hill is restricted to the United States. Kamyr has other affiliations in Canada and other foreign countries.

Sales representatives of Sandy Hill are generally familiar with the Kamyr equipment and are authorized to discuss and sell both parts and complete installations. On several occasions, salesmen have informed customers of capabilities which the Kamyr equipment is not designed to handle. In instances such as these, more qualified engineering representatives have visited the customer and explained the design characteristics of a KAMYR installation. At the present time Sandy Hill has two men who are fully qualified to sell, estimate costs, and resolve engineering problems associated with Kamyr equipment.

With one exception, salesmen who sell Kamyr equipment are salaried personnel. For ten years Sandy Hill has had a West Coast representative who handles the equipment on a commission basis. His sales effectiveness is difficult to evaluate inasmuch as he devotes only part of his effort to Kamyr sales. (It is estimated that his Kamyr sales amount to less than one fifth of his total sales of all equipment he sells.)

The graph, Figure 6-3, indicates a steady rise in Kamyr sales over a period of ten (10) years. As evidenced by some of the testimonial correspondence received from satisfied customers, the Kamyr equipment is fulfilling the claims of economy, capacity and quality which Kamyr has claimed.

6.19 Appraisal of Marketing. The present organizational set-up wherein Sales and Manufacturing are under one Vice-President was undoubtedly the most expedient action at the time the decision was made. Because "Sales" and "Manufacturing" are in themselves the two most important functions of a company such as Sandy Hill, each function should be assigned to an individual who devotes his entire efforts and attention to one major area. To continue under the present system will result in Sales and Manufacturing operating below an efficiency which could be achieved if each

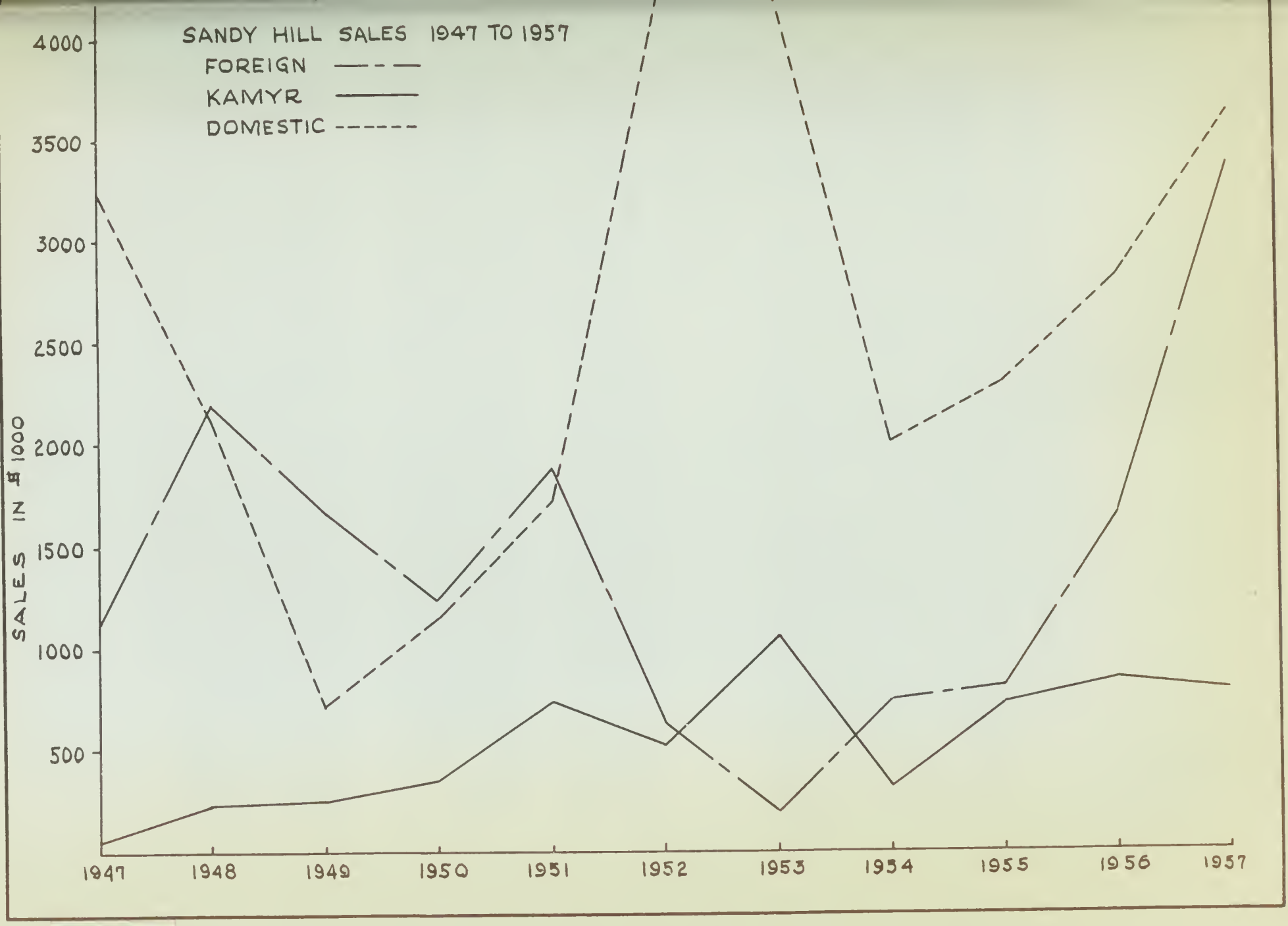

SANDY HILL SALES 1947 TO 1957
FOREIGN
KAMYR
DOMESTIC
SALES IN $ 1000
4000
3500
3000
2500
2000
1500
1000
500
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957

FIGURE 6-3

function was a separate individual's responsibility.

Since personal contact and professional competence are principal factors in establishing customer confidence, whatever efforts and expense Sandy Hill has expended to gain customer goodwill have definitely proved beneficial to the success of the company. However, in a market where present capacity exceeds demand, every paper industry machinery company will be hard put to maintain the present level of employment and financial success. Additional attention and effort must be assigned if Sandy Hill is to continue to prosper. This extra effort must be by management personnel whose competence will add prestige to the name "Sandy Hill" and who must find new and more customers for all types of equipment.

6.2 Advertising.

6.21 General. The advertising and sales promotion programs are under the direct supervision of the Assistant Vice-President. He is aided in the performance of these duties by an assistant who also performs the public relations functions for the company.

There are no big advertising or sales promotion campaigns conducted by Sandy Hill. This is partially due to the fact that most equipment made by the company is that of known design and/or improvements in an old design. Since paper and pulp machinery is expensive, any new ideas or changes in designs must in general be proved before they can be sold.

6.22 Advertising Budget. The annual amount for this department is usually less than 1/2 of one percent of total sales. The final budget has no direct relationship with the sales program. An annual estimate is made based on historical records and past performance. Special items which are anticipated for each year are included in the estimate which is submitted to the President for approval. If the situation so dictates the budget for the current year may be revised at any time at the discretion of the President.

6.23 Advertising Media. Prestige advertising is conducted in six or seven trade magazines both weekly and monthly. The number of pages are evenly divided between the various publications on an annual basis. The cost of this advertising amounts to approximately 50% of the present budget for this department.

Each month every paper and pulp mill in the United States receives a letter or pamphlet which is directed toward a certain aspect of the equipment made by Sandy Hill, such as, pumps, driers, drives or head boxes. In addition, there are approximately 200 foreign customers who receive this same type of information through the mails. The technical information for these pamphlets is provided by Sandy Hill to an outside advertising agent who works under contract for the company and actually prepares the layouts for release.

The local monthly "organ" published by the company is mailed to those paper and pulp mills which have requested this publication. There are several hundred companies on this mailing list.

There are numerous pamphlets which include photographs that are prepared for the use of the sales personnel in presenting and explaining the various products to the customers.

A new catalogue is under preparation by the company. This publication will present detailed information on Sandy Hill products and capabilities. It will be of valuable assistance to both salesman and customers in their understanding of the products and their capabilities. Since this catalogue is relatively expensive, it is being prepared in sections. Each section is complete in itself and can be used prior to the completion of the catalogue in final form. There are several colleges and universities which use the current Sandy Hill catalogue as a reference book in teaching various aspects of paper making.

The company also participates in various trade shows and meetings through direct attendance by most of the top executives of the company. At these gatherings, displays are utilized as appropriate to let their production capabilities be known to potential customers.

Sandy Hill has had a very limited radio and television advertising campaign. To date the biggest effort consisted of participation in a recent special program which was carried over local stations concerning the paper industry in this part of the State of New York.

The local press relations are considered good by the company. It is the policy of the company to participate fully in all local civic functions. It is noted, however, that only a very small percentage of their sales are made as a result of the local market.

No motion pictures are made or used by the company for advertising or sales promotion purposes.

6.24 Appraisal of Advertising. Sandy Hill is considered to be relatively conservative in its advertising and sales promotion programs. According to information contained in "Budgeting", an average advertising budget for industrial concerns amounts to approximately two percent (2%) of total sales. Sandy Hill's budget is less than 1%. In a limited study conducted in 1956, by Woodward, Voss, Kevenor, Inc., it was indicated that where Sandy Hill was known, their reputation was generally good. However, it was pointed out that Sandy Hill was not too well known by the industry as a whole. It is most difficult to determine the amount of return which is realized from each dollar spent on advertising. In this connection, however, we feel that the average amount spent by the industrial producers for advertising is indicative of their considered opinion as the the optimum amount which should be spent and would therefore provide a good yardstick for determining an advertising budget.

6.3 Sales.

6.31 General. Sandy Hill management personnel have emphasized that "everyone's a salesman". The exactness of the comment cannot be disputed. The continued practice under prevailing processing routines has led to unpredictable delivery dates for promosed equipment. It is common knowledge that some sales are consummated, and the company committed

to a completion date without taking into consideration how this new work will affect scheduled work. In some instances an order was accepted, manufacture had started and the sales department still had not been notified of the order, either formally or informally. This has resulted in conflicting completion dates and unexplainable delays. How much a delay or repeated delays has affected customer relations is not readily ascertainable.

A study of two randomly selected samples of customer orders was made to analyze promised and actual delivery dates. One hundred fifty-seven (157) orders handled during September 1957 was one sample. One hundred sixty-two (162) randomly selected orders from among a total of six thousand four hundred fifty-three (6453) orders covering a three-year period (1955-57) was the second sample. Lack of uniform procedure in assigning a promised delivery date and changes in the manufacturing schedule resulted in many orders being delivered ahead of schedule and many more orders delivered from one to one hundred thirty (130) days after the promised delivery date.

Analysis of the samples showed these results:

September 1957 Sample	Three Year (1955-1957) Sample	Equipment Delivered
30	50	After promised delivery date
35	22	Before promised delivery date
35	32	On the promised delivery date
34	32	"As soon as possible", "RUSH"
--	18	No promised delivery date
23	8	Unknown
157	162	

Approximately twenty percent (20%) of each sample listed the the orders for delivery "as soon as possible", "rush" or "immediate delivery". Although some of the orders were bona fide "rush" or "breakdown" orders, there appeared to be no set procedure for so indicating a top priority job.

Personal visits by salesmen and management account for approximately fifty percent (50%) of all orders placed. The remaining fifty percent (50%) comes through paper making company inquiry at time of breakdown or is the result of a previously satisfied customer who relies upon Sandy Hill to deliver in accordance with promised delivery.

Figure 6-4 is an analysis of orders, by months, for the period January 1955 to April 1958.

6.32 Selling Policies and Procedures. Selling policies or objectives, as such, are not spelled out in definite terms. As a broad objective for this year the goal is to achieve a total sales of five million dollars.

Salesmen know the total amount of orders placed in their territories in previous years and also have a goal for "expected" sales during the current year. These amounts and goals are established by the Vice-President, Sales and Manufacturing.

Sales effort and supervision is under the personnel attention of the Vice-President, Sales and Manufacturing. Each of five (5) salesmen who works directly out of Sandy Hill submits a weekly itinerary which is reviewed and approved (or revised) by the Vice-President, Sales and Manufacturing. As regular procedure, each of these salesmen submits a weekly report which lists the company, date, city, man interviewed and subjects discussed. Some of these remarks become the jumping-off point for visits by more technically qualified personnel, or become the basis for submitting a temporary proposal. The salesmen who are in areas remote from the home office submit monthly reports containing the same information as that submitted by those who work out of the home office.

Those salesmen who operate from the home office usually spend three weeks on the road and one week of each month in the home office.

All salesmen, except one who is exclusively in Kamyr, are paid an annual salary. They are employed on the basis of verbal agreement, with exception of the Kamyr representative, who has a written contract.

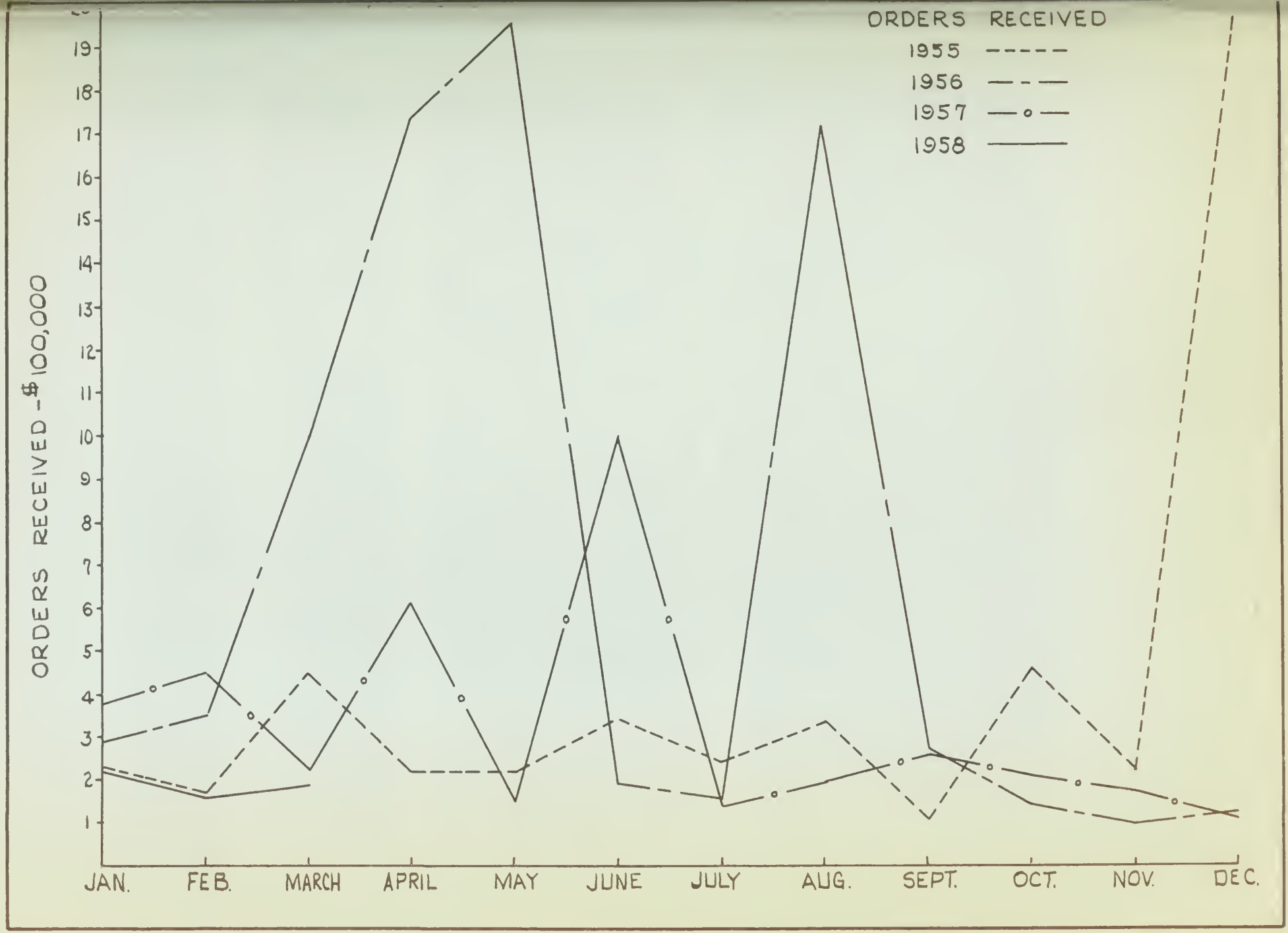

ORDERS RECEIVED
1955
1956
1957
1958
ORDERS RECEIVED - $100,000
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN.
FEB.
MARCH
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.

FIGURE 6-4

One procedure the company uses for follow-up on potential customers is the form letter mailed to customers approximately two months after a preliminary quotation was submitted. The letter includes a return address card which provides data explaining the current status of the inquiry. This letter and card have proved beneficial in keeping prospective customers aware of Sandy Hill's interest in their customers and provide a periodic check for the Sandy Hill sales department. This consolidated list for follow-up is maintained in the home office. Approximately every two months the cards are given to the salesmen, along with resume of other interrogations about equipment. The salesmen use this compilation for planning their visits and talks. Relative importance of factors which ultimately result in a sale are: (1) Customer satisfaction because of engineering know-how; (2) Service and lastly, (3) Price.

Monthly sales meetings are held in the office of the Vice-President, Sales and Manufacturing, at which time suggestions are given each salesman and he discusses the job problems in his area and the status of jobs which he expects to close in the next three months. The President, Vice-President, Sales, First Vice-President and Secretary-Treasurer, Assistant Vice-President and salesmen who work out of the home office attend. On accasion the salesmen from remote areas attend this meeting which is usually held on the first Monday of each month. During each meeting, one hour is devoted to discussion and presentation of a special subject or the explanation of a piece of equipment for the purpose of acquainting salesmen with details of the equipment.

The Vice-President, Sales and Manufacturing, conducts a personal review of salesmen travel and expenses. If at any time the salesman's salary and travel expenses total above 5% of the sales over a three-month period, that particular salesman receives a notification of this fact from the Vice-President and continued poor performance will lead to termination of employment.

For "off-the-cuff" estimates of job orders, salesmen get information from the Vice-President, Sales and Manufacturing. For "break-down" jobs, those where a paper manufacturer's plant is shut down and he needs the repair to continue operations, no estimate of cost is made and work is billed on a "cost plus"

basis. The charges for the job depend upon the urgency of the needed repair, the tear-down and set-up of the work in progress at time time the repair work is to start in the shop. Shop personnel often commit the company to work for a customer, but only rarely commit the company to the cost of the work to be performed.

At the present time a multi-paged pamphlet is available for recording data which salesmen collect during visits with prospective customers. The booklet, because of its bulkiness, has grown into disuse. At best, only two or three sections of this pamphlet are used as a general rule. This means that either the whole pamphlet is submitted with only a few notations in the booklet, or else the pamphlet is not used and information is submitted in either letter or memorandum form. In our discussions with engineering and estimating personnel, we were informed that there were many cases of salesmen providing insufficient information for both quotations and orders.

6.33 Financing Policies. Quotations and billing for Sandy Hill equipment are all F.O.B. Sandy Hill, Hudson Falls, New York. As a general rule terms are 25% down at time of order, 25% in 60-90 days, 25% at time of shipment and 25% within 30 days after shipment.

On larger orders, terms are 25% down, progress payments billed as work progresses and the last 25% payable 30 days after delivery.

At the present time the Sales and Manufacturing Department does not have a firm annual budget. Through the periodic reports submitted by the Comptroller, the President is aware of the expenditures of the Sales and Manufacturing Department. Any questionable expenditures which the Vice-President, Sales, has planned are discussed with the President prior to having funds committed.

6.34 Order Processing. The procedure for processing an order depends upon the type and background information available for that particular order. As a general rule the "orders" fall into three basic categories; (1) those which had a quo-

tation or estimate prepared prior to the receipt of the order; (2) those which are an original order for work to be performed - and will require an engineering review, and an estimate; and (3) those which are requests for work of a frequently recurring nature for which current records are adequate and available.

Figure 6-5, Flow Process Chart of an order, shows the flow of an order similar to one falling under (1) above. A random sampling of orders of this type was made and it was found that three days was an average time from receipt of order to acknowledgment and distribution of local work order to all concerned.

The time to process an order falling under category (2) above (those requiring engineering review and an estimate), was dependent upon the time required for the special study in each area. The time the order awaited engineering completion depended upon complexity of the job and the manpower available to perform the work.

Orders falling under category (3) above were processed in much the same manner as those under category (1).

During the year 1955 a total of 2264 orders were processed; in 1956 a total of 2371 orders were processed and in 1957 a total of 2100 orders were processed. Based on these totals and two hundred sixty working days per year, approximately nine orders were processed each day.

For those orders which followed a normal routine it was found that an order travelled approximately 672 feet and was examined, checked or approved by eight persons before work orders and letters of acknowledgment were released. The present office building layout is such that an order starts on the main floor, descends one level, returns to the main floor, ascends to the second floor, returns to the main floor and again descends to lower level. (From the above information it appears that much time and personal attention is devoted to processing each order. Although it is realized that Sandy Hill feels this personal attention is justified, it appears that some of it is unnecessary and could be eliminated.)

ORDER PROCESSING FLOW CHART

DESCRIPTION	MONDAY	TUESDAY	WEDNESDAY
MAIL ROOM	◎—D→ ORDER OPENED BY MAIL CLERK. DELAYS UNTIL ALL MAIL OPENED — TO RECEPTIONIST		◍ SEND ACKNOWLEDGEMENT LETTER
RECEPTIONIST	◍ —STAMP AND RECORD IN LOG —HAND CARRY TO ORDER DEPT. FOR ORDER NR. ASSIGNMENT —HAND CARRY TO SALES ESTIMATOR		—ACKNOWLEDGEMENT LETTER FILE COPY
SALES – ESTIMATOR	◍ CHECK PURCHASE ORDER AGAINST QUOTATION (PRICE - TERMS - SPECIFICATIONS) TELEPHONE ESTIMATOR FOR HOURS ALLOWED ENGINEERING ATTACH COPY OF QUOTATION WITH ORDER HAND CARRY TO COMPTROLLER	◍ RECEIVES CREDIT APPROVED ORDER HAND CARRY TO ORDER DEPT.	KEY: ◎ - ORIGIN ◍ - ADD TO ⇨ - TRANSPORTATION D DELAY
COMPTROLLER	◍ CHECK CREDIT – INITIAL AND STAMP TO CERTIFY RATING AND TERMS HAND CARRY TO SALES ESTIMATOR — D		
ORDER DEPARTMENT	◍ ASSIGNS SHOP ORDER NR.	◍ CHECK CORRESPONDENCE CHECK SPECS. WITH ESTIMATOR CHECK DELIVERY OR ASSIGN DELIVERY DATE PREPARE ACKNOWLEDGEMENT LETTER FOR CUSTOMER → PREPARE SANDY HILL WORK ORDER	
SALES			—SALES COPY – ACKNOWLEDGEMENT COPY
ENGINEERING			—ACKNOWLEDGEMENT COPY
CARPENTER SHOP			—COPY OF WORK ORDER
MACHINE SHOP			—COPY OF WORK ORDER
ERECTION			—COPY OF WORK ORDER
METHODS			—COPY OF WORK ORDER
PURCHASING			—COPY OF WORK ORDER
SHIPPING			—COPY OF WORK ORDER
BILLING			—COPY OF WORK ORDER

FIGURE 6-5

6.35 Sales Engineering. Sales engineering in the true sense of the term is done upon the request of a customer, as outlined in paragraph 6.1 or whenever a Sandy Hill salesman is confronted with a problem which requires an expert's investigation and resolution. Nine Sandy Hill salesmen have engineering backgrounds and have either worked in the Engineering Department or a pulp or paper mill. With such backgrounds the salesmen can provide the general technical service in connection with the sale and use of their products.

As part of a continuing program to improve the sale and knowledge of Sandy Hill products, a new loose-leaf, sectionalized catalogue is being prepared. As sections of this catalogue become available, they are distributed to salesmen, customers and prospective customers.

With regard to the engineering service for Kamyr equipment, Sandy Hill has established a general policy of providing the expert services of the Vice-President, Pulp Machinery or the chief engineer whenever such assistance is deemed advisable.

Because Sandy Hill equipment is the type which is specially built to fit a particular need, engineering or technical service is an important factor in consummating a sale. Through Sandy Hill engineers, the company makes a thorough study of the customer's needs. Quite often this involves designing a special component for a machine or making modifications in previously built machinery.

Although there is no separate group established for sales-engineering, the qualified executive personnel and engineering force are constantly available on call to give advice and help in working out difficult problems in development, installation and use of the equipment built by Sandy Hill.

6.36 Salesman Training. At the present time salesmen are selected on the basis of previous experience in manufacture or engineering of paper making equipment and the intuitive appraisal by the Vice-President, Sales. Because it is known, or at least assumed that sales personnel are familiar with

their prospective customers no formal training program for all sales personnel is in effect. During monthly meetings approximately one hour of each meeting is devoted to a lecture and presentation of the details and operation of a specially selected piece of equipment.

Sales personnel are expected to carefully scan current trade publications to get leads on expansion or changes in equipment. From that starting point they establish their contacts for sales.

6.37 Appraisal of Sales. Although there can be no doubt about everyone being a salesman at Sandy Hill, the lack of a standardized procedure for classifying orders and reporting sales results in a disorderliness which is unnecessary. Undoubtedly some of this seemingly "too informal" way of handling orders is attributed to the personal knowledge and confidence each individual has in the other and in his work. A simple, easily administered system of classifying orders will ensure successful performance with less confusion, less taxing of the individual for independent action, and a greater awareness by all of what is "going on". A system which depends upon an individual's knowledge and familiarity with the status of a job order will cease to function effectively when that particular individual is absent or permanently removed.

The present policy of having top management visit customers and making engineering talent available whenever and wherever needed has undoubtedly created confidence in and prestige for Sandy Hill. If this has been the chief contribution to the financial success of the company during a period of prosperity in the entire industry, it appears greater attention to this type of activity is now required to substantially increase sales.

6.4 Estimating.

6.41 General. The estimating department is under the immediate supervision of the Head of the estimating department. There are nine people who work in the department at present.

In addition, there are several other persons who occasionally do estimating for specific specialized jobs but are not assigned to the estimating department.

The Head of the Estimating Department works under the general supervision of the Secretary-Treasurer, the Vice-President of Sales, the First Vice-President and the President. Actually the Secretary-Treasurer is more directly involved with estimating than are these other officers. The Head of the Estimating Department does have several officers to whom he must report at various times.

Today at Sandy Hill it requires considerable experience to be an effective estimator and to supervise the estimating department. This is due primarily to the technical nature of the product, the custom nature of the many jobs, and the present systems of estimating in regard to the application of cost figures to the various jobs.

There are three individuals within this department who are authorized to sign the information requests, estimates, and quotations. Any one of these three persons signs the majority of the requests which are given by Sandy Hill. The President signs those requests which amount to considerable sums of money.

6.42 Estimating Procedure: Requests, Propositions, Quotations.

There are three general categories of requests which are received by Sandy Hill:

First, a simple request for information. This type usually concerns a request for general information in regard to the capability to make a given product, time required to make it, type of material, and various types of repair jobs. These requests for information may be received through the mail or over the telephone from one of the salesmen or any number of customers. In either case, each individual request is assigned a number for identification purposes. The numbers are assigned in chronological order by the receptionist. All of these requests are handled by the personnel within the estimating department. The information and answers to these requests are based upon data taken from historical records of

former jobs which are maintained within the estimating department.

The second type of request is called a quotation. This involves the price of a given job as distinguished from the information inquiry. Quotations are handled in the same administrative manner as the information requests noted above. However, since quotations involve a price, they are based on a specific proposal in which more detail and accuracy is required.

The quotations are made from the data taken from the records maintained by the estimating department. These estimating records are historical in nature and are abstracts of data taken from the costs cards which reflect the actual costs which were required to do a previous similar job or jobs. This cost determination involves labor, materials, casting weights, engineering hours and general overhead. The cost estimates for repeat or similar jobs are simply total costs taken from historical records which are then brought up to date by use of the Bureau of Labor Standard index. The percentage figure taken from this index is applied to this total cost and provides the basis for the estimated cost which is quoted to the customer. Jobs which are entirely new or different involve many unknown costs, since no similar historical records are available which can be used as a guide in the cost determination. In general, the more engineering time spent on an estimate or quotation, the more accurate the final cost estimate becomes. However, since many of these quotations never materialize into orders, a certain amount of judgment must be exercised as to how much is spent for these engineering costs. The general policy followed by Sandy Hill is that if a quotation requires more than two engineering man hours for preparation, a special authorization must be obtained from the order/planning department for an authorization number. Before the authorization number is issued, the order/planning department must obtain approval of the First Vice-President, Engineering, in order to expend the additional amount required.

The third general category is called a proposition. This is distinguished from the information request and quotation in that it is usually closer to an actual order. Since this is the case, the planning department assigns a proposition

number against which all preliminary engineering and other costs can be charged to the specific job. All proposition numbers have the letter "P" as a prefix. When a proposition becomes an order the "P" is dropped and the proposition number is then the order number. The preliminary cost for a proposition is usually anticipated to be somewhat greater than are these costs for an inquiry or quotation.

6.43 Estimating Procedure: Pricing. The costs for the estimate sheet are obtained in general from the records maintained by the estimating department as noted above in paragraph 6.31. Listed below are the various categories and sources of cost information which go to make up a job estimate:

Information Supplied by	Cost Category	Basis of Price	Where Obtained
Estimating	Material	Price of each item	From cost cards
Estimating (Sometimes Foundry)	Castings	Per pound	From cost cards
Estimating (Sometimes Shops)	Labor (Includes all overhead)	Labor hours, Present rate/hr $9.75 + special tool charge	From cost cards
Engineering (Sometimes Estimating)	Engineering	Estimated total hours or 6.2% of total cost	Engineering (or cost cards)
Pattern Shop	Patterns	Cost of patterns 1-3% of costs of new patterns required	Percentage applied
Estimating	Erection	6 to 7% of total material, castings, and labor charge	Percentage applied

Information Supplied By	Cost Category	Basis of Price	Where Obtained
Estimating	Boxing, Painting, Shipping	Domestic - 5% of total cost of material, castings, labor. Foreign - 8% of above total to port of N.Y.	
Estimating	Profit	10% of all above costs	Percent applied
Estimating	Royalties (if any)	Contracts	Applied as appropriate
Estimating	Agents' fees (if any)	5% of all above costs	Percent applied

The total of all the above cost categories equal the quotation price which is given to the potential customer.

The general policy of Sandy Hill is to try to fit the costs to the job. If estimated costs indicate the job will be priced too high to sell, the components costs on the estimate are adjusted. One of the common adjustment methods utilized is to take a portion of the engineering costs out of the quotation price and charge that portion to sales overhead or to development. These costs may be later recovered by charges to future orders. In order to put a sales engineer on the road to follow up on a proposition, the estimated costs range from $100.00 to $125.00 per day plus milage at 9@ per mile. Costs of this kind can soon price an order out of the market. This is particularly true when related to small orders. The Head of the Estimating Department has a certain latitude in pricing jobs and exercises his judgment as to exactly what and how these preliminary costs are handled. The Secretary-Treasurer, or Vice-President, Sales, or the First Vice-President are consulted in those cases where charges of more than several hundred dollars are involved. In those cases where estimates for work for more than $10,000 dollars are involved, the above officers of the company submit the estimate to the President for review and approval.

The need for work in the plant sometimes has an influence on the quoted price. Additionally, the competition and general trend in pricing is usually known to Sandy Hill and is thus a factor in price determination. The price is not always the final determination as to who gets the job. Other factors of importance are quality, service, previous relationships, present orders and competition. All of these influence the final decision as to who actually gets the order.

The original inquiry or quotation is considered tentative and is usually so noted by Sandy Hill in their reply to the potential customers. The price is sometimes subject to re-negotiating once the order is obtained. This is particularly true if the customer requests certain changes or modifications to the equipment once the engineering and manufacturing process has begun.

6.44 Estimating Appraisal. The estimated costs as obtained by the present procedures do not appear to be based on adequate specific information. The system permits the company to be committed to various jobs at a specific price which may or may not provide an adequate profit. It is realized that all jobs do not necessarily have to provide a profit. However, if this is the case it should be known to the company before the job is accepted. This situation exists because specific information as to standard costs for jobs is not available to the estimating department.

The basic costs records which the estimating department use as a basis for the estimated or quoted price are not always the same for similar jobs performed at different times. The main reason these job costs vary is because of the company policy to retain the labor force at a fairly constant level irrespective of short-range variations in work load. This results in having direct labor pace their effort and productivity in accordance with the pressure to meet production schedules. Utilizing the present system, the estimator is doing a fine job when he guesses right and a bad job when he guesses wrong. In both cases certain items in the estimate may be based on the same identical method or procedure, i.e., a "feel for the job".

The total costs which results from a detailed procedure of utilizing cost records, together with several es-

timated factors, provides a final price which is quoted to the potential customer. The final price which is thus obtained includes many "best guesses". The quotation is sent out to the various customers over the signature of one of the three persons in the estimating department. Thus the company is committed to a price which in many instances contains unknown costs factors. In addition, in many cases only the estimating department is aware of the final price which is quoted to the customer. In general only "estimating" knows the exact costs and procedures which were utilized in establishing these specific cost factors of the quotation.

Since experience is most important in the estimating department, there appears to be no provisions whereby someone could step in and replace the Head of that Department. The Secretary-Treasurer could provide temporary relief for the job but only at considerable expense to his present position with the company.

6.5 Market Sales/Research.

6.51 General. Market and Sales Research at Sandy Hill is not established in a formal organization. However, members of top management and sales personnel have a wealth of information concerning the immediate future market and trends. This knowledge of what the customer will need and approximately when he will want a particular piece of equipment is acquired by various methods. Top management personnel, through their everyday reading of trade and financial journals learn of proposed expansion and development programs. Through discussions with their many personal contacts in the paper and pulp industry, they learn about projected overhauls, changes and expansion programs. Whenever such casual information is sufficiently encouraging to warrant follow-up, a member of top management makes a personal visit to the prospective customer with the intention of offering to submit a quotation on the proposed work.

Salesmen uncover much new and unexpected information in their dealings with buyers. In instances where they feel a more qualified person should develop the lead, the

Vice President, Sales, is notified and one of the top management team makes the visit to the prospective customer.

As a regular practice, Sandy Hill has good representation by top management at the various trade meetings. These meetings have provided the initial contact and interest which has often led to sizeable orders at some later time.

For a company the size of Sandy Hill the type of marketing analysis it has conducted has proved successful in the past. We believe Sandy Hill could improve its position in the pulp and paper industry machinery field if the presently available talent assigned more time and effort to formally gathering, recording, and analyzing data about the character, quantity and trend of demand. In doing the above, a thorough, continuing search of pulp and paper production growth should be made by type, area, quantity and projected demand and expansion.

*Six members of the R.P.I. Management Group are currently doing a marketing research study of pulp and paper production in the United States and Latin America and will submit a copy to Sandy Hill when the report has been completed.

6.6 Recommendations.

Marketing: We recommend that:

1. Present Sales and Manufacturing Department be divided into separate departments, one for Sales and one for Manufacturing.

2. Domestic, foreign and Kamyr sales be consolidated under the Vice-President, Sales.

Advertising:

3. Consideration be given to increasing the advertising budget up to 1-2 percent of the sales goal for the subsequent year. This increase should be used to make Sandy Hill better known in the industry.

4. New and direct methods be found through which potential customers may be made more aware of Sandy Hill and its capabilities through greater distribution of special literature combined with more personal contact and follow up.

5. Questionnaires be developed and utilized to find how Sandy Hill has become known and apply this information to the media which has proved best in this respect.

6. The local organ "Chips" be continued and that the mailing list be increased to cover all potential customers. Consideration be given to the possibility of utilizing the advertising layout pieces as part of the direct mail literature.

Sales:

7. Centralized control for all orders be established in the Sales Department. Sales would establish office processing routine, classification ("routine" or "rush") and customer contact in regard to status of order.

8. Top Management establish broad sales objectives for the company which in turn could be utilized by the Vice-President, Sales, in setting goals for salesmen.

9. Salesmen be put on salary and commission rather than continue on present salary and bonus system of compensation. (Although it is realized that transactions occur at irregular intervals and that development and service work is required, it appears that a commission on sales would be an incentive to increase sales. Present system ofawarding bonus on over-all company prosperity is too indefinite.

10. If salesmen are retained on the present salary and bonus system, establish a quota in each territory and set bonus as a percentage of the sales within the salesman's territory. If establishing a quota is impractical, base the bonus upon a merit rating system. As suggested in "Budgeting" performance could be measured by (a) Sales; (b) Public Relations; (c) Expense Record; (d) Balanced Selling; (e) Selling Activity; (f) Teamwork. Whatever system is employed, the salesmen should know the details of the system.

11. During the weekly production review, establish changes in delivery dates of work in process and scheduled production. Upon determination of delays, notify each customer of the change in delivery date.

12. A more intensive KAMYR educational and training program be conducted for all salesmen so that field personnel are familiar with limitations of equipment, operation and maintenance savings in the use of this equipment.

13. Engineering Department and Sales Department prepare a brief, practical, data recording form to be used by all personnel who submit information to these departments for the purpose of preparing inquiries, propositions and quotations.

Estimating:

14. Standard procedures be developed to obtain consistent actual job costs for labor, materials, and overhead and that these costs be used as a basis for price quotations.

15. The Vice-President, Sales, through the estimating department control the final quoted price based in part upon the actual job costs provided by Manufacturing and Engineering. All variable costs should be segregated from fixed costs so that the sole price will reflect its contribution to the fixed costs of the establishment. Thus, the final quoted price would be determined by the needs of the company for the sale, competition, and market conditions. The estimated job costs obtained from Manufacturing and Engineering should not be changed without consulting the appropriate department.

16. Engineering and Manufacturing Departments be held responsible for the control of the actual job costs in their respective departments. These costs should be held within the estimated costs provided to Sales or estimated costs as revised by consultation. Major deviations therefrom would require justification.

17. The Vice-President, Sales, be assigned the function of estimating.

18. Foreign and domestic quotations for all Sandy Hill equipment be combined and handled by the estimating department.

Market and Sales Research:

19. The executive committee (Chapter I, paragraph 1.9) be established. Quarterly meetings be held to investigate, recommend, formalize and review broad policy and objectives for the company. The sales and marketing experience of these company officers should also be channeled into a formal organization for a continuous and systematic appraisal of market and sales potential.

20. The Sales Department obtain the following publications: (1) Pulp and Paper Prospects in Latin America, 1955, United Nations - Food and Agriculture Organization; (2) World Pulp and Paper Resources and Prospects - 1954, United Nations - Food and Agriculture Organization (UNESCO) (ECE) (ECLA) and that Sandy Hill be put on the mailing list for United Nations information on paper and pulp product development in Latin America and South America.

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